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Man, Leisure, and Wildlands: a complex interaction

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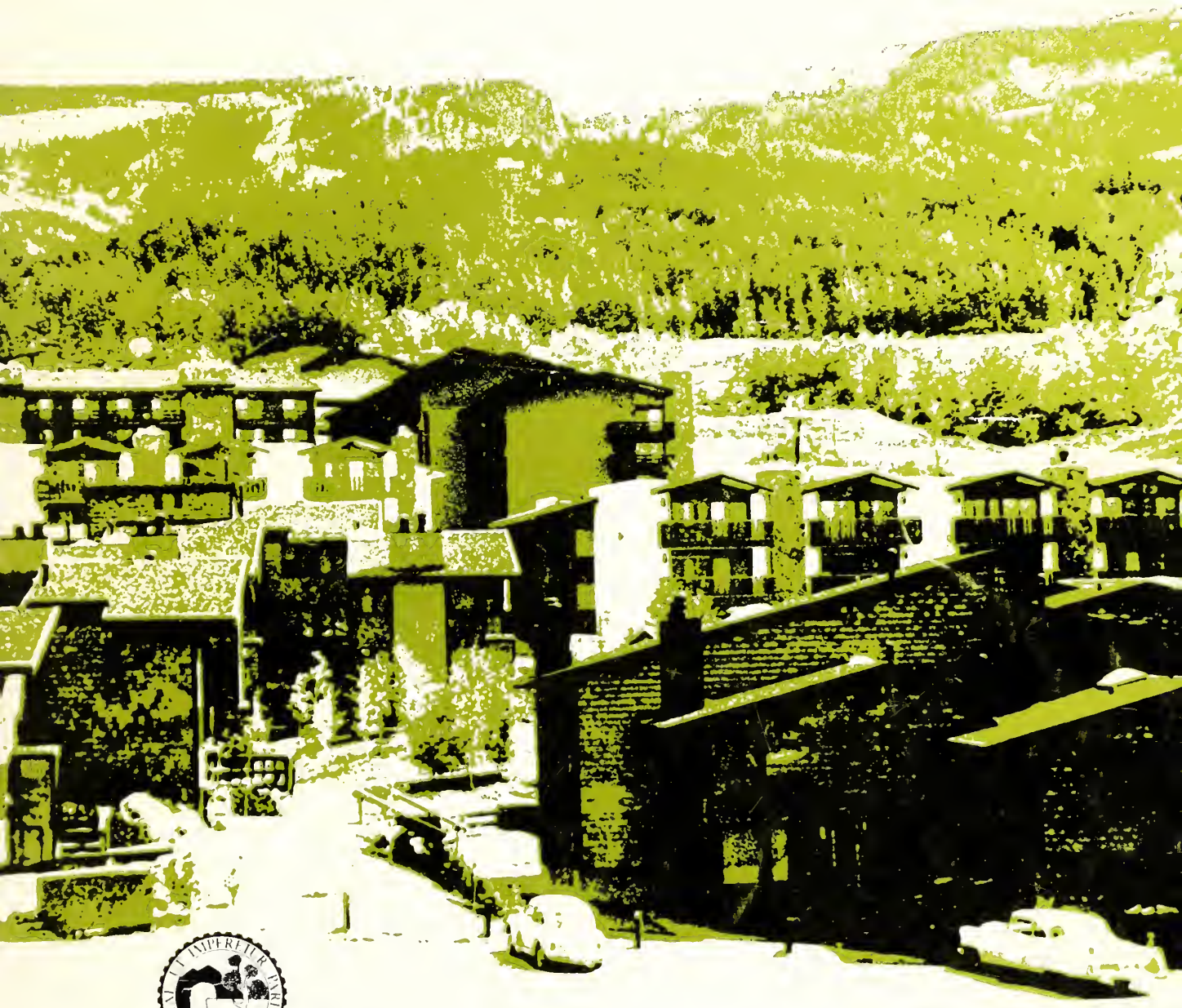
Vail, Colorado
September 14-19, 1975



Eisenhower Consortium For Western Environmental Forestry Research

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Eisenhower Consortium Bulletin 1

MAN, LEISURE, AND WILDLANDS:

A COMPLEX INTERACTION

Proceedings of the First Eisenhower Consortium Research Symposium, Sept. 14-19, 1975, Vail, Colorado

Eisenhower Consortium
for Western Environmental Forestry Research

NATURE TO BE COMMANDED MUST BE OBEYED

ACKNOWLEDGMENTS

The planning and successful implementation of a research symposium is by no means a task one takes lightly. Coordinating the input of an organization comprised of nine universities and a Federal agency over a five-state region compounds the complexity of such a mission.

Despite the complexity, the Eisenhower Consortium decided that, after three years of research effort in a wide range of environmental problems, a state-of-the-art symposium was needed. The purpose and objectives of the symposium are enumerated in President Welch's Foreword.

In any organization, the key to success is reflected in the capacity of the units within the organization to work in concert towards a common set of objectives. Implicit is a high level dedication and motivation of numerous individuals.

Many people contributed directly to this symposium. First was the tremendous effort of the planning core committee consisting of David Herrick, Gordon Lewis, Robert Dils, William H. Welch, and David Thorud. These people were the principal idea generators and organizers for the symposium. I must also give special recognition to the staff of the Rocky Mountain Forest and Range Experiment Station for their spirited assistance throughout the project.

Special recognition is due Tom Evans, Supervisor of the White River National Forest, and District Rangers Tom Bell and Larry Larson for setting up and directing an excellent field tour.

The full support of Dean Anson Bertrand of the College of Agricultural Sciences at Texas Tech University is greatly appreciated.

Each of our Consortium delegates assisted with the planning and arrangements. Each served as a program head for a section of the symposium.

There would have been no symposium without the spirited cooperation of the speakers and attendees. This enthusiasm was manifest in the high-quality presentations and group interactions which made the symposium. Quick publication of these proceedings--a major planning goal--depended on the cooperation of the authors in preparing their papers in final form, ready for photo-offset reproduction.

This symposium, then, is a reflection of the spirit of dedication and cooperation which has been a hallmark of the Eisenhower Consortium since its founding in 1972. No project coordinator could ask more from people who have given so much.

James D. Mertes, Texas Tech.
Symposium Coordinator

FOREWORD

THE SITUATION

A hundred years ago, settlers and transients swept West, seeking homes and fortunes. Their impacts on the environment were unplanned, unregulated. They cut trees, mined minerals, hunted wildlife, and their livestock grazed the ranges. Parts of the West are still recovering from that first westward migration.

Now a new and different wave of "settlers and transients" is surging into the central and southern Rocky Mountains and adjacent High Plains. They come as home seekers and vacationers. They differ from their predecessors in that they have enough money to reinvest part of it in pleasure—using the natural environment for personal enjoyment. So many people are making homes or vacationing in this region that their activities endanger the very open-space environment they came West to enjoy. Nature needs some well-planned help to cope with this second wave.

WHAT CAN BE DONE?

A key to dealing with open-space problems created by concentrated use is knowledge—of the ecologic consequences of use, of the ability of nature to absorb the effects of use, and of the degree to which demands for different levels and kinds of use can be satisfied.

Ten western research institutions have joined forces to fill some of these critical knowledge gaps. Nine universities and the Rocky Mountain Forest and Range Experiment Station (USDA Forest Service) have formed the Eisenhower Consortium for Western Environmental Forestry Research.

The Eisenhower Consortium pools a broad spectrum of research talent and expertise to find solutions where man-environment problems are most urgent in the West: the central and southern Rocky Mountain region and associated High Plains. It selects problems, establishes priorities, formulates research programs, solicits research proposals, and channels Forest Service and other research funds to member universities to solve identified problems.

CONSORTIUM GOALS AND PLANS

The goals of this consortium are to: (1) increase understanding of the interactions between people and the environment; and (2) develop methods to provide for the needs and wants of increasing permanent and transient populations while maintaining, and enhancing where possible, the attractive features of the environment.

The Consortium makes its findings available to resource planners and managers— the people who guide resource allocation and use, and make on-the-ground decisions. These planners and managers need more sound information than they now have if they are to make decisions that will perpetuate clean water, beautiful surroundings, the harvest of forest and range resources, peace and quiet, space to be alone.

The intent of the Consortium is to provide commissions, planning boards and agency administrators with facts to help them chart coordinated, environmentally sound open-space planning and development programs for public and private lands.

It is toward these goals that this symposium on Man, Leisure, and Wildlands--the first to be sponsored by the Eisenhower Consortium--is addressed.

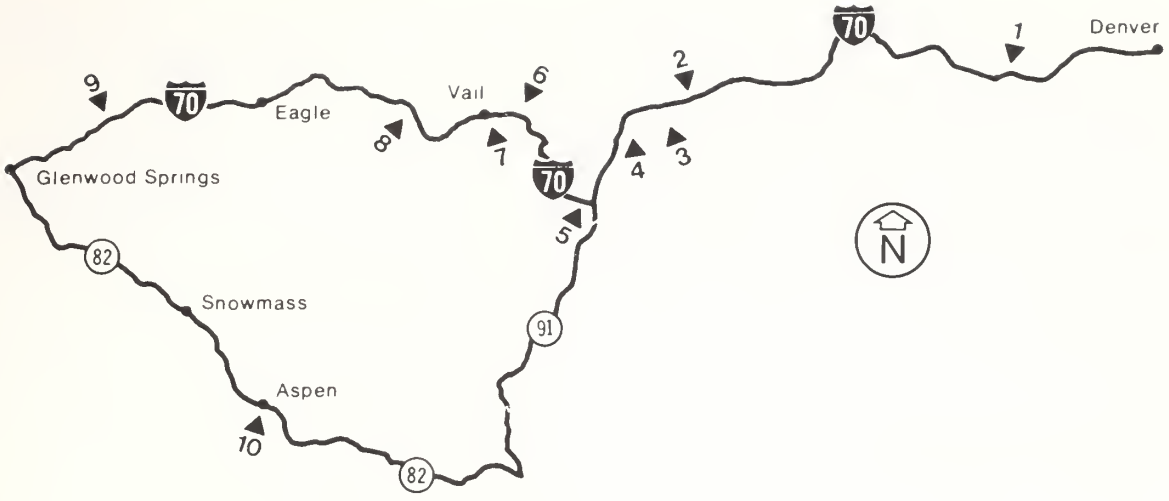
H. William Welch, President
Eisenhower Consortium

THE TOUR

September 14-16

THE SYMPOSIUM

September 17-19



TOUR NOTES

1 Front Range Mountain Developments

Various subdivisions, primarily in the foothills area, from west of Lakewood to Floyd Hill east of Idaho Springs. A recent offering at Genesee Mountain covers lots selling from $24,000 to $45,000 each. Nearby is "Arapahoe East," a small ski area that also offers night skiing. Numerous condominiums are available in and adjacent to Georgetown further west.

Large-lot foothill subdivisions west of Denver.

2 Eisenhower Tunnel (Interstate 70)

East portal of the Eisenhower Tunnel, which routes I-70 beneath Loveland Pass. Loveland Basin ski runs converge near the entrance.

First Bore

1. Start of Construction: 12-4-67
2. Opened to Traffic: 3-8-73
3. Cost of Construction: $113,000,000 or $12,500 per l.f.
4. Length: 1.7 miles
5. Design Capacity: 900 vehicles per hour one way
6. Opening day traffic (25 hours): 17,000 vehicles--mostly sightseers
7. Peak traffic to date: 1380 vehicles/hour--one way 8-74 19,483 vehicles/day
8. Elevation of portals: 11,015' east and 11,155' west or 1.64% grade

Second Bore

Six separate construction contracts covering different phases are proposed. The Second Bore will follow the alignment of a 10 ft. diameter pilot here to the south of the completed tunnel. Approximately 100 feet of undisturbed rock will remain between tunnels. Work will include 2 miles of approach roads for the Second Bore.

1. Estimated start: 4-75 - Advertise electrical and mechanical work; 5-75 - Advertise tunnel excavation w/concrete lining; 9-75 - Actual excavation expected to start.
2. Length: 1.7 miles
3. Estimated cost: $116,000,000
4. Estimated Completion Date: 1979

3 Keystone Ski Area

Year-round resort complex with golf, swimming, tennis, etc., conference facilities, hotel, condominiums, shops, restaurants, etc. Opened in November, 1970, it is owned and being developed by the Ralston Purina Company. Currently it occupies 512 acres of private land and utilizes 2,280 acres of Arapaho National Forest land (under special use permit) to operate seven ski lifts with a capacity of 7,200 skiers per hour. Use during the '73-'74 season amounted to 173,300 skier visits.

Pitkin County's comprehensive planning program was described during the tour stop at Keystone.

4 Dillon Reservoir

Completed in 1964, it stores water that is diverted via the 23-mile-long Roberts Tunnel to the eastern slope for use by the city and county of Denver. The earth-fill dam, 231 feet high, impounds 258,000 acre-feet of water with a surface area of 3,400 acres and 25 miles of shore line when full. Numerous public recreation sites, including five campgrounds, five picnic areas, five boat launching ramps and a concessionaire-operated marina are available at the area.

Marina and resort condominium development at Dillon Reservoir. Several major ski areas are within a 15-minute drive.

5 Copper Mountain Ski Area

Year-round resort complex with swimming, tennis, riding, etc., conference facilities, condominiums, shops, restaurants, etc. Opened in November, 1972, it is owned and is being developed by Copper Mountain, Inc. Currently, it occupies 280 acres of private land and utilizes 2280 acres of Arapaho National Forest land (under special use permit) to operate seven ski lifts with a capacity of 8,000 skiers per hour. Use during the '73-'74 season amounted to 181,900 skier visits.

6 Interstate 70

I-70 is now being built over Vail Pass and through Gore Valley. Side-slope cuts are shaped and revegetated (vertically lined area) within 12 days after the earthwork has been completed. This joint effort of the Forest Service, Department of Transportation, and Colorado Division of Highways minimizes soil erosion and water quality deterioration. Gore Creek flows just below the earthwork.

The Colorado Division of Highways archaeologist described a current excavation on top of Vail Pass, on a site to be developed for a rest area. His findings indicate Indians hunted and butchered here some 6,000 years ago.

7 Vail Ski Area

Year-round internationally-known resort with swimming, tennis, riding, golf, hiking, etc., conference facilities, lodges, condominiums, shops, restaurants, etc. Opened in December, 1966, it is owned and being developed by Vail Associates, Inc. Currently, it occupies 353 acres of private land, primarily at the base area, and 6707 acres of White River National Forest land (under special use permit) to operate sixteen ski lifts with a capacity of 15,500 skiers per hour. Use during the '73-'74 season amounted to 673,200 skier visits as opposed to 280,484 skiers during the '67-'68 season. Summer attractions include the nearby Gore Range-Eagles Nest primitive area and Mount of the Holy Cross country.

Gore Creek flows through Vail. The floodplain is maintained as an attractive greenbelt.

This network of ski trails constitutes a part of the Vail special use permit on the White River National Forest.

8 Beaver Creek Ski Area

The skiing potential in this area south of Avon has been discussed for the past fifteen years and it was officially recognized in 1969 by the Forest Service's inventory of potential ski areas on the White River National Forest. The area was also later designated as the alpine events site for the '76 Winter Olympics for the ill-fated bid by the City of Denver.

9 Glenwood Canyon (Route for Interstate 70)

In November 1973, a citizen's committee appointed by the Governor requested that the Colorado Division of Highways seek independent design concept studies for the routing of Interstate 70 through Glenwood Canyon. As a result, the CDOH contracted the three consulting firms renowned for their accomplishments in the fields of engineering, architecture, aesthetics, and environmental design. Total cost was $270,000, or $90,000 per firm.

The design concepts for the routing of Interstate 70 through Glenwood Canyon were presented by the three firms at Denver and Glenwood Springs in July 1974. A summary of each concept follows:

Vollmer Associates

1. Estimated cost: $150,000,000, excluding right-of-way acquisition and relocation of utility lines. Some interstates in New York have cost as much as $26,000,000 per mile.
2. Proposal places highway on the north side of the Colorado River throughout.
3. The 12.6 mile section from completed I 70 east of No Name Creek to the Canyon exit at Siloam Springs would be a combination of terraced roadways and a double-decked parkway/truckway structure.

Howard, Needles, Tammen, & Bergendoff

1. Estimated cost: $110,000,000, excluding right-of-way acquisition, relocation of utility lines.
2. Both traffic lanes approximate the alignment of the present highway on the north side of the Colorado River. The only exception is where the eastbound lanes cross to the south side of the River at Bear Creek (2500 feet east of Grizzly Creek) and remain there for 1.5 miles before crossing back to the northside at the present left-hand curve approximately 600 feet east of the Shoshone Plant.
3. Concept follows a more conventional type design, with a combination of terraced roadways and elevated structures at critical locations, plus twin tunnels (east of Hanging Lake) 1400' long.

Gruen Associates

1. Estimated cost: $192,000,000, excluding right-of-way acquisition and relocation of utility lines.
2. The first 3.9 miles extending east from the completed section near No Name Interchange would follow closely to the present alignment on the north side of the Colorado River. This section would be the more conventional type design with a combination of terraced roadways and elevated structures next to the River.
3. Approximately 1700 feet west of the Shoshone Plant, the eastbound lanes cross to the south side of the River to a point 500 feet east of the Plant before crossing back to join the westbound lanes.
4. At a point 2000 feet west of the Shoshone Dam, both lanes cross the River, pass under the railroad, and enter twin tunnels for 1.3 miles before exiting near the

The mouth of Glenwood Canyon on the Colorado River. Routing of I-70 down the scenic canyon is highly controversial.

south River bank. After crossing over the railroad, the highway would be adjacent to the River for 1.6 miles. It then crosses over the railroad again and enters twin tunnels for 0.4 miles, then emerges on elevated structures for 1000 feet before entering a third set of tunnels for 0.1 mile. It then spans a deep draw on high structures. After crossing a plateau on grade, the lanes skirt the Bair Ranch some 800 feet to the south on a viaduct of high trestles. About 3400 feet east of the Bair Ranch, twin tunnels are entered for the fourth time for approximately 0.6 miles before over-passing the railroad and crossing the River to join the recreation road approximately 1500 feet east of the unique rock crevices identified as the Bookcliffs. Common alignment for both lanes then continues near the existing road for the remaining 0.6 miles to the Canyon exit at Siloam Springs.

Of the three concepts submitted, the Gruen proposal was definitely favored by a majority of those expressing opinions at the public meetings held. This was understandable because of the pro-environmental attitude of many of those in attendance. While more expensive than the other concepts presented, it definitely attempts to achieve a balance between environmental and transportation demands. It provides an entirely separate scenic route for six miles through the eastern half of the Canyon, which is considered more unique in character and more sensitive to the impact that a four lane highway would place on it.

While perhaps strictly conjecture, all indications are that a routing similar to the Gruen proposal will eventually be accepted. While more difficult and expensive to do, public demand may insist that additional alignment changes be made in the western half of the Canyon.

10 Aspen, Maroon Bells

Tour participants enjoyed hot coffee during a cool stop at the Maroon Bells recreation area on the White River National Forest.

Internationally-known winter and summer resort town adjacent to four major ski areas (Aspen Mountain, Aspen Highlands, Buttermilk Mountain and Snowmass, which is partially developed) with a total of 46 ski lifts with a capacity of 32,115 skiers per hour and a total vertical drop of 12,400 feet for the four areas. The areas occupy 10,376 acres of White River National Forest land under special use permit, plus 2,737 acres of private land. The total use for the '73-'74 season amounted to 1,260,200 skier visits as opposed to 523,959 visits during the '67-'68 season. All areas, except Aspen Highlands, are owned and operated by the Aspen Skiing Corporation. Cross country or touring skiing is also available in the Ashcroft area, Hunter Creek, and at Snowmass.

Summer attractions include the famed Maroon Bells mountain peaks and Maroon Lake, the nearby Maroon Bells-Snowmass Wilderness, and the annual summer-long series of music concerts.

Land Adjustment Plan: Snake River Basin, Arapaho National Forest[1]

Larry L. Larson, District Ranger
Dillon Ranger District

PURPOSES

The purpose of this plan is to classify individual tracts of private land in the Snake River Basin as to their suitability and availability for retention in private ownership or acquisition for National Forest purposes. Also, as well as tracts of National Forest lands suitable for development and which are available for disposal through exchange procedure. It indicates desirable adjustments in land ownership to be taken to meet objectives of the Basin.

OBJECTIVES

The overall National Forest goal is to achieve a pattern of resource uses and land ownership pattern that will best meet the needs of people now and in the future. Specific objectives are defined in the Snake River Basin Unit Plan, of the Dillon District, Arapaho National Forest, and in the Snake River Basin Guidelines, of the Summit County Planning Department. Specific objectives extracted from these documents which can be furthered by the adjustments in pattern of land ownership are:

1. Provide for orderly development and/or use in the Snake River Basin in a manner which will maintain the present high quality environment with regard to scenery, air and water quality, year-long outdoor recreation, wildlife and open space values.
2. Preserve the area's rural character.
3. Determine those areas of the basin which, from a physical standpoint, are best suited for development, and guide development of these areas.
4. Accommodate growth and development in the Snake River Basin in a manner which will strengthen the economic base in Summit County.
5. Encourage a pattern of development which poses an economical and feasible pattern of public service on the county as possible.

The basis and reasoning behind these objectives and the resulting management direction and coordinating requirements, is outlined and evaluated in the Draft Environmental Impact Statement for the Snake River Basin Land Use Plan.

URBAN ENCLAVES

These enclaves include those private lands suitable for development having approved subdivision zoning, and those National Forest lands suitable for exchange to private owners for development. Their purpose is to limit future population densities within the enclaves.

Three urban enclaves were identified in the land use plan for the Snake River Basin. They are: Ski Tip, Keystone, and Soda Creek. Together they comprise 2,494 acres, or 4% of the total Basin. National Forest lands include 702 acres or 28% of all lands within the three enclaves. Urban enclaves usually conform to legal subdivisions but may be irregular in shape. They are influenced by private land ownership patterns and are dependent upon the suitability of the land to support planned development.

The urban enclaves are areas of existing or anticipated significant urban development. These are areas of high density human habitation where the majority of resulting socio-economic needs are met. They are an integral part of the environment in that significant impacts to the surrounding natural resource areas and local demands for resource allocation originate here. There have been 5,095 dwelling units approved to date by Summit County in the Snake River Basin, with completed construction of approximately 10% of this total.

[1] Draft of a functional land adjustment plan developed as part of the Snake River Basin Use Plan, presented at Keystone during the Eisenhower Symposium Tour. Specific details of the Plan are still subject to minor changes.

Nearly all of the approved units are within these enclaves. These enclaves are within the foreground view from existing and/or planned urban facilities. Structures may be for residential, commercial, industrial, transportation, utilities, and public service uses. A mixture of these structures is found within the existing resort area and mountain subdivisions contained within the enclaves.

In the planning process, the three urban enclaves were grouped into a Special Multiple Use Management Zone termed the "Urban Zone". This zone was established for the purpose of developing specific management direction and coordinating requirements for these enclaves which have a similar management situation. The management direction and coordinating requirements served as a guide for the development of this Land Adjustment Plan.

MANAGEMENT DIRECTION AND COORDINATING REQUIREMENTS

Management direction and coordinating requirements for the Urban Zone is not specifically shown in the Regional Guides. As a Special Zone, management direction is established in accordance with laws, regulations, policies, and the primary purpose for which the zone is classified.

Management Direction

Manage ecosystems within the Urban Zone:

1. To retain natural scenic beauty of the U.S. Highway 6 Scenic Corridor.
2. To maintain the critical deer and elk migration route between Soda Creek and Tenderfoot Mountain.
3. To maintain or enhance present recreation fishing values.
4. To preserve the historic townsite of Keystone and the Cold Spring cabin.

Coordinating Requirements

Land adjustments program will:

1. Retain or improve the integrity of fishing, and the quality and recreation use of streams by maintaining the riparian vegetation and flood plain in an undeveloped nature in National Forest status and open to public use.
2. Consolidate land ownership to maintain or increase the critical migration corridor on National Forest lands between the Keystone and Soda Creek urban enclaves and to provide additional forage for wildlife management purposes, wherever possible.
3. Maintain the natural beauty of the Scenic Corridor of U. S. Highway 6 by retaining National Forest lands and obtaining scenic easements to separate development into urban enclaves.
4. Phase exchange actions to the development of sewage plant capacities, water supplies, and social services; and coordinate actions through local government such as the Summit County Planning Department, Regional Planning Commission, and Board of County Commissioners.
5. Emphasize land acquisition on those tracts suited for recreation, needed for management of wildlife and forage, and which will help retain the rural character of the planning unit by confining growth to urban enclaves. (See land ownership adjustment map.)
6. Encourage urban growth to occur downstream from the confluence of the Snake River and its North Fork in the land ownership adjustment program to minimize effects on air quality as well as other natural resources, and socio-economic impacts.

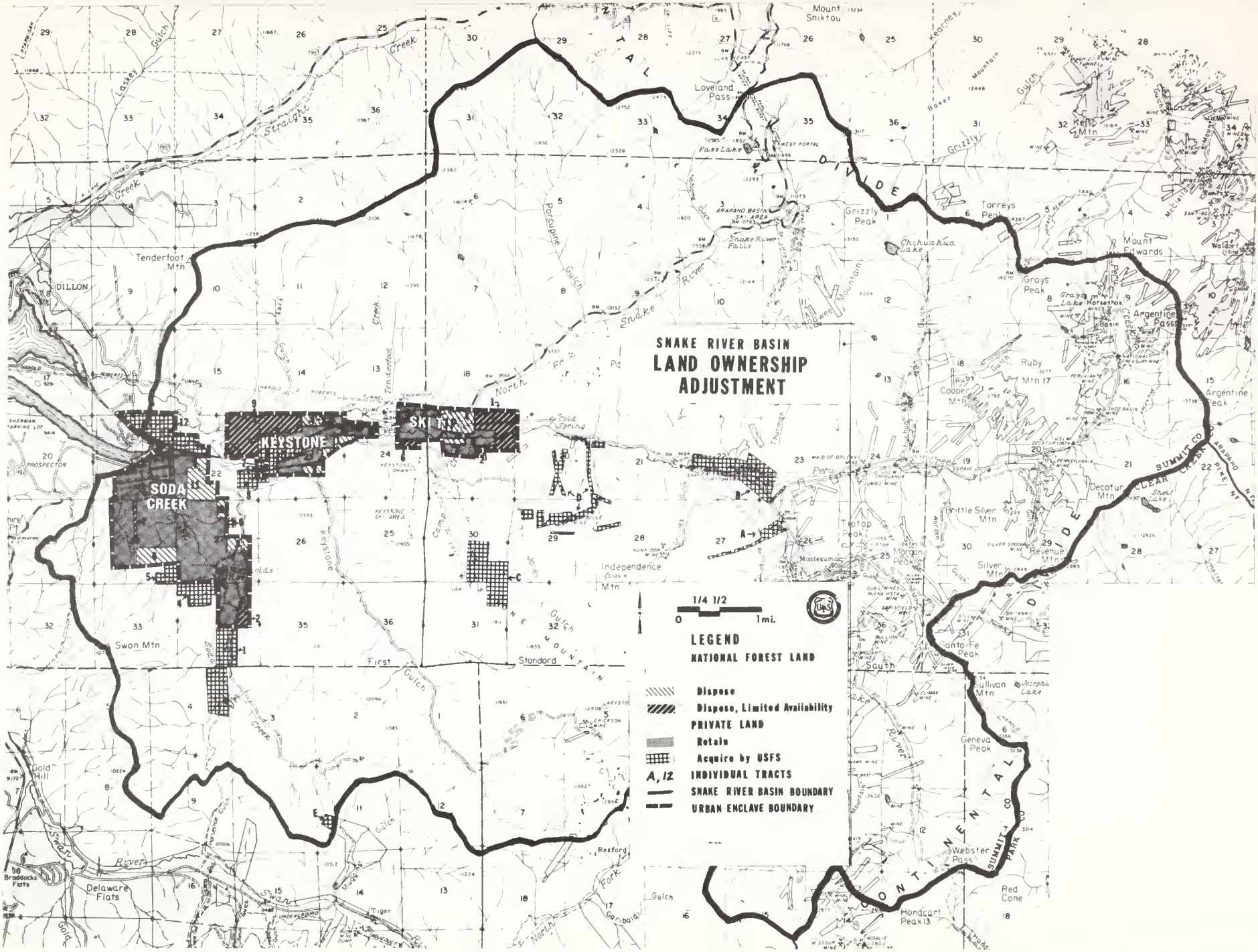
PROCEDURE

Tracts are delineated by physical characteristics, current ownership status, and management constraints. Numerical identification for each tract is by urban enclave. Tracts outside urban enclaves but adjacent to them are included in that enclave's numerical sequence. Isolated tracts are identified by alphabetical sequence.

Classifications used are:

National Forest Lands

1. Retain-tracts which are suitable for National Forest purposes and which are unavailable for exchange.
2. Disposal-tracts which are suitable and available for exchange purposes.


SNAKE RIVER BASIN
LAND OWNERSHIP ADJUSTMENT
KEYSTONE
SKI AREA
SODA CREEK
1/4 1/2
0
1 mi.
LEGEND
NATIONAL FOREST LAND
Dispose
Dispose, Limited Availability
PRIVATE LAND
Retain
Acquire by USFS
A, 12
INDIVIDUAL TRACTS
SNAKE RIVER BASIN BOUNDARY
URBAN ENCLAVE BOUNDARY
CONTINENTAL DIVIDE
Mount Sniktou
Loveland Pass
Grizzly Peak
Torreys Peak
Mount Edwards
Chihuahua Lake
Tenderfoot Mtn
DILLON
Snake River
Porcupine Gulch
Keystone Gulch
Peru Creek
Ruby Mtn
Argentine Pass
Argentine Peak
Decatur Mtn
Brittle Silver Mtn
Revenue Mtn
Silver Mtn
Montezuma
Independence Mtn
Morgan Peak
Santa Fe Peak
Geneva Peak
Webster Pass
Red Cone
Handcart Peak
Swan Mtn
First Gulch
Standard
Gold Hill
Swan River
Delaware Flats
Braddocks Flats
Resford
Tiger
Sullivan Mtn
Joseph Lake
SUMMIT CO
PARK CO
CLEAR CREEK CO
ARAPAHO NF

3. Disposal, limited-tracts which are suited for exchange purposes but available only in exchange for private lands within the Snake River Basin.

Private Lands

1. Retain-tracts which are not suitable for National Forest purposes even if available.

2. Acquire-tracts which should be acquired to meet essential National Forest resource management objectives.

   Priority 1 - Key tracts urgently needed.
   Priority 2 - Future key tracts or tracts needed for consolidation.
   Priority 3 - Remaining desirable tracts.

The "Land Ownership Adjustment Map" and "Adjustments Summary" tabulation are an integral part of this plan.

CLASSIFICATION

1. Patented mineral claims not individually identified in this plan are classified as "Retain-Private". It is felt that due to the mineral character of these claims, it would not be in the public interest to exchange for them. They could later be filed upon and eventually become private land again by complying with existing mining laws and regulations. Control of land uses to meet the objectives for the Snake River Basin is within the jurisdiction of Summit County authorities under provisions of local regulations and state statutes. Cooperation between local authorities and the District Ranger will provide the management necessary to regulate mining activity on both private and federal lands.

2. National Forest lands not individually identified in this plan are classified as "Retain - National Forest".

3. Isolated tracts outside Urban Zones

Tract	Action and Reason or Purpose
A	"Acquire - Priority Level 2" - This group of mining claims lies within the inventoried ski area site of Independence-Bear Mountain. The current land use plan provides for retaining the option open to develop the area. It will not be developed unless the current plan is revised and NEPA provisions are completed.
B	"Acquire - Priority Level 2" - same as tract A plus limited amounts of dispersed recreation opportunities.
C	"Acquire - Priority Level 1" - this tract will provide for expansion of the existing Keystone Ski Area into Jones Gulch.
D	"Acquire - Priority Level 2" - this scattered claim also lies within the Independence-Bear Mountain inventoried winter sports site.
E	"Acquire - Pirority Level 1" - this tract is part of the larger Muggins Gulch parcel. It is needed to provide long term management of the big game winter range and calving area important to the Soda Creek elk herd.

Ski Tip Enclave

Tract	Action and Reason or Purpose
1	"Dispose - Limited" - This tract is suitable for urban development. Only lands within the urban enclaves of Ski Tip, Keystone or Soda Creek will be considered in exchange for this tract. Portions of this tract within the flood plain or which are too steep for development are not available for exchange in order to maintain or enchance esthetic, recreation and fishing values.
2	"Acquire - Priority Level 3" - Consolidates ownership if tract 1 is not disposed of under availability constraint. It is located in the flood plain with the needed potential future recreational opportunities. Precludes areas being suitable for National Forest purposes at an acceptable cost level.
4	"Dispose to Private" - Retain flood plain lands within tract and dispose of balance suitable for development.

5	"Retain-Private" - Same as tract 3.
6	"Dispose-Limited" - Suitable for urban development, but also suitable for National Forest purposes, in conjunction with existing Keystone Resort. Final decision to dispose is deferred at this time. Changing public needs and associated development of the mountain and resort area are variable and cannot be determined at this time.

Keystone Enclave

Tract	Action and Reason or Purpose
1	"Dispose" - Suitable for urban development and confines development to suitable lands north of Keystone Road.
2	"Retain-Private" - Developed.
3	"Dispose to Private" - Eastern two-thirds of tract suited for urban development. Established road right-of-way through tract will be retained.
4	"Dispose" - Eastern and lower one half of the tract are suitable for development. Unsuitable portions on steep sagebrush hillsides are not available for exchange to maintain the scenic integrity of U. S. Highway 6 and eliminate possible impacts on the water resource.
5	"Acquire - Priority Level 1" - Portions needed to preserve scenic integrity of U. S. Highway 6 and other portions needed for fishing opportunities on Snake River.
6	"Acquire - Priority Level 1" - Portion needed because of fishing attributes and as a north-south corridor for big game travel between Keystone and Soda Creek Enclaves.
7	"Acquire - Priority Level 1" - Portion needed because of fishing attributes, the Keystone Historic Townsite, and as a north-south corridor for big game travel between Keystone and Soda Creek Enclaves.
8	"Acquire - Priority Level 1" - Portion needed as a north-south corridor for big game travel between Keystone and Soda Creek Enclaves.
9	"Dispose - Limited" - Suitable for urban development. Transportation and sewage system must be extended for development. Availability limited to exchanges for lands in tracts 5, 6, 7, and 8. Development would be removed from scenic travel corridor by this exchange and a critical migration route and a historical townsite would be preserved.

Soda Creek Enclave

Tract	Action and Reason or Purpose
1	"Acquire - Priority Level 1" - Needed to preserve critical big game winter range and critical migration route necessary to meet basin management objectives. One of original homestead dwellings in Summit is included and will be preserved and recommended for historic designation.
2	"Dispose - Limited" - Suitable and available on limited exchange basis to consolidate development.
3	"Retain - Private" - Suitable for development. Land prices paid for property were high enough to preclude acquisition of National Forest purposes at reasonable costs.
4-5	"Acquire - Priority Level 1" - Needed to provide additional big game winter range. Confines development and reduces adverse effects of the urban zone on wildlife.
6	"Dispose" - Suitable for development. Consolidates ownership and provides an opportunity for land exchange negotiations for tract 4 and tract 5.
7	"Dispose - Limited" - Suitable for development. Availability limited to disposal to (tract 3) adjoining land owners.
8	"Dispose" - Suitable for development, consolidates ownership and

provides opportunity for land exchange for tracts 1 and 9.

9 "Acquire - Priority Level 3" - Suitable for development. If acquired consolidates developed areas and offers a land exchange opportunity to dispose of tracts 8 or 10.

10 "Dispose" - Suitable for development. Consolidates development area and provides opportunity for land exchange offer for tracts 1 and 9.

11 "Dispose" - Tract is suitable for urban development. Consolidates development and provides opportunity for land exchange for tract 1 and 9.

12 "Acquire - Priority Level 2" - Suitable for development but also needed to preserve the integrity of the scenic travel corridor of U.S. 6 and protect big game winter and a critical big game migration route between Soda Creek and Keystone Enclaves. It is possible that management objectives can be met through a scenic easement restricting development to that existing on the tract.

SNAKE RIVER BASIN (Acres)

	National Forest Lands			Private Lands		
	Retain	Disposal	Disposal-Limited	Retain	Acquire	Total
Ski Tip Urban Enclave		105	98	230	5	438
Keystone Urban Enclave		65	200	200	110	575
Soda Creek Urban Enclave		234	0	1126	121	1481
All Urban Zone		404	298	1556	236	2494
Outside Urban Zone	52389			2509	848	55746
Total - Snake River Basin	52389	404	298	4065	1084	58240

ADJUSTMENTS SUMMARY (Acres)

Isolated Tracts

Private Lands

Tract	Acquire
A	37
B	200
C	160
D	120
E	10
Total	527

Ski Tip Urban Enclave

Tract	National Forest Lands		Private Lands	
	Disposal	Disposal-Limited	Retain	Acquire
1		80		
2				5
3			70	
4	105			
5			160	
6		18		
Total Within Urban Enclave: Snake River Basin	105	98	230	5

Keystone Urban Enclave

1	25			
2			200	
3	20			
4	20			
5				40
6				70
7	(Keystone Historical Site - Outside Urban Enclave)			(15)
8	(Outside Urban Enclave)			(35)
9		200		
Grand Total	65	200	200	160
Less Keystone Historical Site and Area Outside Urban Enclave				50
Total Within Urban Enclave - Snake River Basin	65	200	200	110

Soda Creek Urban Zone

1	(Outside Urban Enclave)			(171)
2	20			
3			1126	
4	(Outside Urban Enclave)			(60)
5	(Outside Urban Enclave)			(30)
6	80			
7	4			
8	20			
9	(Outside Urban Enclave)			(10)
10	20			
11	90			
12	(45 acres Outside Snake River Basin)			166
Grand Total	234	0	1126	437
Less Area Outside Urban Enclave				271
Total Within Urban Enclave	234	0	1126	166
Less Area Outside Snake River Basin				45
Total Within Urban Enclave Snake River Basin	234	0	1126	121

The Beaver Creek Story

Dave Mott, Vail Associates
Mike Blair, Eagle County Planner
Ernie Nunn, White River National Forest

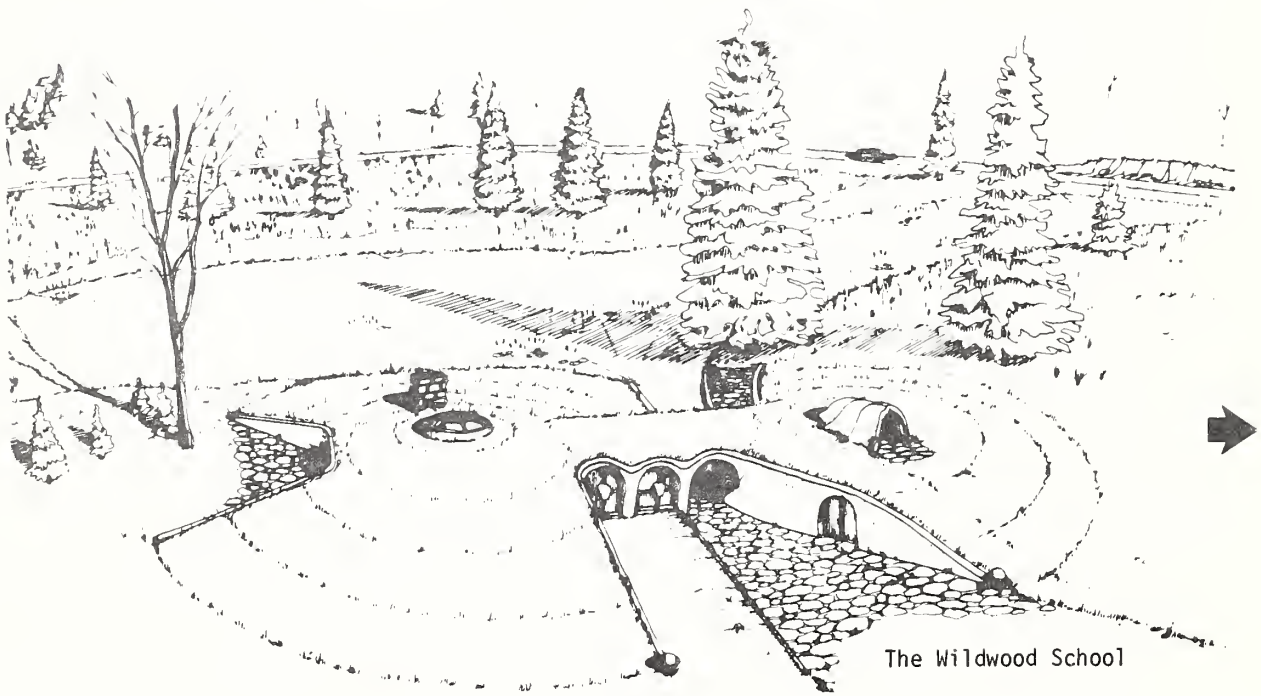
The objectives of this presentation were to discuss the basic land use planning techniques, familiarize the participants with effects of development on Eagle County and local communities, summarize the work involved in preparing the final Environmental Impact Statement, and give the current status of the Beaver Creek Ski Area proposal.

The overview was to reflect concerns of the local governments, ski area proponents, and the Forest Service in relation to overall planning, cost, and interagency relationships in Beaver Creek planning.

Vail Associates, Inc., who owns 2,200 acres of base area property at Beaver Creek has proposed a year-round recreation development that involves approximately 3,000 acres of National Forest land. They applied for a special use permit on March 1, 1974, based on a plan to start construction in 1974 with an initial development opening date in the fall of 1976, and phased development to proceed over the following 12 to 14 years. The estimated quality skiing capacity was set to approximately 7,000 skiers per day.

However, the area became controversial after the filing and review of the final environmental impact statement in August 1974, for the 31,000 acre Meadow Mountain Planning unit that also covered the Beaver Creek segment. Forest Supervisor Tom Evans recommended designation of the segment as an official winter sports site on January 15, 1975. Newly elected Governor Lamm requested Regional Forester William Lucas to delay the designation for ten days. However, on January 24, 1975, the area was officially designated as a winter sports site and the Governor was so informed. Governor Lamm, on January 29, 1975, then requested an administrative review of that decision by filing an appeal, and the Sierra Club Legal Defense Fund joined the Governor as a co-appellant several days later.

The planning of Beaver Creek was probably the most critiqued process and involved the participation of more individuals and groups than any other resource planning project that has ever occurred in Colorado.



The Wildwood School

The Wildwood School

Robert B. Lewis
Educational Research Group, Aspen, Colorado

Wildwood is a pre-school for children aged 3 to 6 years, whose goal is to foster an 'environmental ethic' during a person's earliest, most receptive years. Development of an ethic, like that of a religion, starts early. The 'consumer ethic' is instilled by our culture from the day of birth. It is not merely the product of conscious commercialization, such as advertising, but of most of the manmade environment that represents American life.

In contrast, Wildwood aims to replace this 'consumer ethic' with an 'environmental ethic' — an understanding of the ecological balance on this planet and the mutual interdependence of man and nature. The program focuses on children during their earliest learning years, since even high school is often too late to change attitudes formed from birth. In Wildwood the children will learn not merely through precept in a formal teaching program but through the examples set by the activities of adults and through the total learning environment itself. They will be encouraged to inquire and discover things for themselves, to pursue their special interests and talents, and to proceed at an individual pace. Relations among all members of the school community will be relaxed and open. Although Wildwood is in the mountain valley of Aspen, its concept and construction are founded in simplicity, and it is intended as a prototype that could be adopted by most school systems in any country.

Since what and how a child learns is greatly influenced by the learning environment, Wildwood is built to be as much a part of the natural environment as possible. The site for the school is a gently sloping hillside within an aspen grove. Nearby are streams and ponds, willow thickets and a spruce forest. The building conforms to, rather than dominates, this varied landscape. The school is built into the hillside, around the trees and ponds. The architecture is free-flowing and organic, sculpted to the natural features of a site chosen specifically for its irregularities. Rather than fill or level these features, the designers of Wildwood have made every effort to preserve them.

Inside the building, free organic forms continue. Nature is full of curves and so are human creatures. Thus the free-form exterior of Wildwood, constructed with ferro-concrete, is echoed inside with polyurethane foam of a soft, earth-like texture. The foam doubles as an insulator and permits a wide range of room environments, lofts, tunnels, slides and cubby holes.

Most children love caves and Wildwood offers some of that womb-like mystery and security. Yet it is designed to activate the senses, heighten perceptions and renew awareness. Lighting comes through windows overlooking the life of a pond. It comes also through skylights, some of which look out under a flowing stream that fills the room with rippling light patterns. Other skylights are recessed, looking out through short earthen tunnels. Areas of the building not reached by daylight are lit by cove lighting to create a variety of moods and learning environments consistent with the natural environment the children are studying.

Most children love playing with plants and animals, with sand and pinecones, leaves and stones and water. As they play, they learn. Equally natural, it seems, is the attempt of young children to express and translate their experiences through drawing, painting, singing, dramatic play, music, clay sculpturing and story-telling. Art is the medium through which a child, not yet dependent on verbal skills, most easily and naturally expresses his ideas and emotions. Thus nature and art become the twin foci of the Wildwood program, constantly influencing and reinforcing the child's growing awareness and responses to this environment.

Traditionally, schools expect input and output to be in the same medium. If a child is taught certain facts about frogs, for example, he is usually expected to show knowledge of these facts by repeating them in answer to test questions. At Wildwood, however, the child is encouraged to express his new learning through different media — through painting, collage, sculpture, music or simply through play. As he takes in new information and mixes it with his own experience, ideas, impressions and memories, he integrates what he has learned with his growing knowledge of reality and transforms it into personal understanding. This essentially is what a creative person does — interprets, improves, recreates. Thus the child's mind becomes the interface between the natural world surrounding him and the broad spectrum of art. The chipmunk, the cattail or the cricket may not reappear in the same form but they will be better integrated into the child's total experience.

Special equipment and space arrangements within the school help encourage a variety of creative activities. A sunken stage, organically contoured to provide comfortable floor seating as well as play space, offers an area for dramatic play, story-telling and other group activities. Specially designed art and learning centers make materials like sand, water, paint, clay, stones and beads readily available to the child.

'Learning modules' lining the large activity areas provide little rooms, scaled to 5-year-old size, where children can find privacy, look at a book, watch a film loop, or observe a fish in an aquarium. A dimmer-switch allows the child to adjust the light to suit his mood.

Unique to Wildwood are the Sensory Rooms, three small rooms devoted to exercising and sharpening individual senses. The rooms are small enough to enable one child to work alone without interference from over-eager teachers or peer group pressure. The purpose of the rooms is not to teach the child everything about sensory phenomena but merely to help him experience the range of their possibilities. Alone in the Light Room, for example, the child discovers that he can manipulate light intensity. He can play with shadows, refraction, reflection, color. A work table is equipped with lenses, defraction gratings, prisms, mirrors, blindfolds, eyepatches and kaleidoscopes.

In the Sound Room, the child finds a cassette player, amplifier and stereo speakers, and a collection of tape cassettes, including classical and popular music inspired by themes of nature, as well as poetry recitation and recordings of animal sounds and calls. Other materials include a stethoscope, earmuffs and an assortment of musical instruments such as a ukelele, drums or bells.

In the Touch, Taste, and Smell Room, the walls may be covered with cork, slate, velveteen, bark and other tactile materials. On the floor may be inflatable pillows and a cozy bearskin rug. A worktable, parqueted in different textured wood grains, provides space to investigate a collection of cattails, cactus plants, caterpillers and worms.

The blindfold is important equipment in these rooms, for once sight is blocked, the other senses become more acute. Blindfolded, the child may hear new sounds, handle objects of different size, weight, texture, temperature. He may smell with new awareness, fresh pine needles, wet soil, skunk cabbage, or different fruits. Further taste and smell experiments are implicit in the cooking and nutrition program where the child also learns about how we use water and food, what heat does to vegetables and meat, how grains are ground, where milk comes from, how butter, cheese and ice cream are made.

A child whose senses are regularly exercised is better equipped to appreciate a waterfall, recognize the presence of animal life in a natural setting or simply enjoy a fresh spring day. He may also be better equipped to listen to a symphony, appreciate a painting or understand a poem. Our senses are our tools for experiencing the environment. Too often we have dulled them through misuse or neglect. How else could we endure the noxious smog over our cities, the ugliness of many of our housing developments, the cacophony of the daily rush hour or the tastelessness of prepackaged food? Wildwood hopes to educate children to a keener awareness of their surroundings, to develop their full potential for experiencing life, and to encourage greater expectations for this world.

The Aspen Story

Stacy Standley, Mayor

What happens when you take a small exmining community of a couple of hundred acres, and an equal number of souls, and suddenly expect it to behave as the largest ski resort in the world?

The recipe took nearly thirty years. It started with the world's longest single chair lift on the legendary Ajax Mountain in 1946, and currently includes nearly forty lifts on four mountains. The mixture was enhanced with Ed's Beds, backroom retreats, a rundown hotel, and a watering hole. Through the years the blend has expanded to include 12,000 pillows and nearly sixty saloons. A small village called West Village with 5,500 pillows and a big mountain called Snowmass were added to insure success.

Then, all hell broke loose. In 1960, 150,000 skier visits were recorded. By 1974, more than 1.25 million visits were recorded. The city budget jumped from half a million dollars in 1964 to nearly four million dollars in 1974. Retail sales jumped from less than four million dollars in 1960 to nearly fifty million dollars in 1974.

"Growthmania" had taken over the quiet little town. Real estate values were skyrocketing by 22% per year. Tourist beds were increasing by 19% per year. Employment was going up by 14% annually.

Not all the figures were recording success and wealth, however. Per capita income was only climbing by 3% per year, and the cost of living quickly rose to the top five in the country. Law enforcement costs were up 20% per year. Automobile traffic on the two-lane road that connects Aspen with the outside world was crowding the highway at a rate of 17% increase per year.

The city and county administrators battled to regain control of their community. Budget decisions were being based on corrective reaction rather than forward-looking planning and action. Water systems that had existed since the turn of the century were giving up under the new pressure.

Slowing the myriad problems that are the result of accelerating growth was attacked and corrective action taken. A sewer plant was built, a new water treatment facility constructed, the streets paved, and new schools built. The economic disaster that resulted from the closing of the mines years before had been reversed. Aspen was once again a living community.

With that newfound vitality came hard new decisions about the years of success that apparently lay ahead of the town.

The Aspen Economy. --Aspen's retail sales have increased by fantastic jumps over the past fifteen years. But looking only at the yearly trends does not tell the story of the true intricasies of the community's economy.

A simple illustration of the yearly cycle through which the economy struggles demonstrates the seasonal variation. Three factors characterize the fluctuation: employment, effective population, and sales tax receipts.

Sales tax receipts are the most important indicator to the local government since it is on the basis of the town's business performance that the budget is prepared. The winter season of 140 days accounts for less than 40% of the year, yet during that short time over 60% of the revenue is generated. The high dependence upon winter tourism is overwhelming from a government budgeting point of view.

The city budget is prepared in September. The most important element is the assessment of the next year's sources of revenue. That requires looking at the past year's performance, assessing the state of the economy, and predicting the snowfall for the coming season. The only point of certainty is historical performance. All other elements of evaluation are akin to crystal balls and astrology.

Response to Growth Pressure. -- The crushing pressure of wildfire growth finally caught up with the citizens of the community. They cried "enough" in the fall election of 1972, when two non-growth commissioners were elected by sweeping margins.

They set out to reverse the trends of the recent past. Stringent new zoning laws were

passed. The government bureaucracy was cleaned up and sensitized to the needs of the citizens.

In the spring of that year the people of Aspen reaffirmed their dissatisfaction with uncontrolled growth by electing a non-growth mayor, and three council people with similar sympathies.

Initially, the same remedial down zoning activity that characterized the commissioners' first months consumed the mayor and council.

Once the causal problems were being effectively dealt with, the city and county governments turned towards addressing the degradation of the living environment and tourist experience.

The course of action has been to pursue quality, not quantity, in directing the change that has and will continue in Aspen and the Roaring Fork Valley.

With the onslaught of the tourist growth in the late sixties, Aspen was caught short handed. Public facilities were not adequate to cope with the surge of new development. Therefore, the projects of the city and county were directed towards supplying and cleaning up the water, upgrading the electric department, and attempting to direct the growth via a masterplan.

Getting a better hold on the authority to govern and generate revenues seemed a necessary direction for the government to pursue, if they were to successfully reverse the steamroller effect of growthmania. The citizens voted to become a home rule city under the provisions of the state constitution.

With this new-found power came the opportunity to address the future intelligently a and resourcefully. A city planner was added to the staff. His job was to identify the elements that made the community attractive to citizens and tourists--clean air, an uncluttered skyline, stately old Victorian buildings, parks, and pedestrian orientation.

Once identified and recognized as being of intrinsic value, it became necessary to protect and enhance these qualities.

Once again the citizens aggressively responded to a problem, and a 1% sales tax was approved. This tax was earmarked for open space acquisition and preservation. The first use of the fund was to purchase the 212-acre golf course, and lodge. The purchase price was 3.5 million dollars. A lot of money to insure that the entrance to the town would remain uncluttered and pastoral? The citizens and visitors do not think so.

Recently the city purchased much of the land across the road from the golf course, again with the intent of preserving the expansive beauty that is Aspen. Other land purchases followed: Ruby Park in downtown Aspen, the old railroad yards behind the court house, and river front property adjacent to the sewer plant.

With the increase in growth, one of the valuable elements of the Aspen experience was being compromised: clean air. The villain was not difficult to identify; the rest of the country has been living with the problem of the automobile for years.

The answer was obvious. Mass transit has been tried in cities since their inception. The idea may sound absurd in a village of 5,000 inhabitants, but their ranks are swelled annually by threefold for five winter months, and three summer months.

The idea was not absurd and today Aspen has a free bus sytem funded by the tourist and local alike through another penny of sales tax approved by the voters in 1972. To work mass transit must be convenient and fun. Funky old 1920 vintage busses, built to modern specifications, roam the streets complete with stereo sound, helping the tourist enjoy his vacation without dependence upon his car. Aspen's air is another step closer to being kept clean.

The next step in dealing with the car may be development of a light rail transit between Aspen and Snowmass. This project is under investigation presently, and has received favorable comment from the Urban Mass Transit Authority, whose participation would be required if the system were to become a reality.

For the summer esident and visitor alike, the transportion fund is being used to develop a comprehensive trail system, for both recreation and transportation. The trails are a mix of paved bicycle ways and unpaved hiking and horse paths.

The most visible application of the fund is in the downtown commercial core where streets are being closed to vehicles and malled for pedestrians. The malls, nearly two years old, have been enthusiastically received by the tourist and locals in general.

The Problems of Aspen. --The public facilities and esthetic projects that have been undertaken by the city reflect only part of Aspen's reaction to success. There are serious and far-reaching social ills brought about by too much of a good thing.

Pitkin County has the highest crime rate in the state. Drug abuse is a major concern of the town. The youth of Aspen have been financially supported by emotionally abandoned. Employee housing is almost non-existent.

Law enforcement is a major budget item in the city. For 1975, the police budget is 10% of the total budget or $375,000. In ten years the police force has grown from a five man operation to 27. Aspen is not a dangerous community, but it is a community with high levels of transiency and some big city woes.

The police have a difficult job. They must be servants to the citizens, and, at the same time, insure order is maintained. Tourists come to Aspen for fun. They want to do things they don't dare do at home--carry a drink from bar to bar, park on the wrong side of the street, chin themselves on a protruding business sign, and let their kids drink. They really believe they are in an adult Disneyland with no holds barred.

Police are low keyed, friendly, and as unobtrusive as possible. The police chief has no direct law enforcement background, patrol people ride in orange Audi's. A lonesome drunk will get a ride home rather than a hassle.

Teen centers have been tried with limited success to try to deal with the problems of youth. The city has run centers in city buildings and private groups have used city facilities. Recently a youth drug center was established using a house provided by the city. The Touchstone Mental Health Clinic received a grant to develop the program to deal with this major problem.

Employee housing is an area in which the city has not yet taken an aggressive, positive stand. When that time comes, and it must soon, the costs are going to be overwhelming. Aspen has an employee base of in excess of 5,000, most of whom commute many miles up and down the valley from trailer parks to their jobs. This will be the most difficult task facing the government. It may be one that cannot be solved satisfactorily.

Even in the face of rapid change and seemingly unsolvable problems, Aspen has endured, matured, and flourished with a fervor that has made her the premier ski resort of North America.

County Government's View of Ski Area Development and Its Impacts

Allan Blomquist
Pitkin County Manager

On the traditional American scene, the typical small-town mayor is seldom an expert. But Aspen's mayor, the previous speaker, is a ski-area expert. All six of his council members are equally bright and dedicated.

My three bosses, the Board of County Commissioners, are comprised of two top notch lawyers and one very understanding environmentalist.

Thus I am secure in saying that the political leadership in Aspen and Pitkin County is not typical--it's exceptional.

The movement they've started is truly a reform movement--now in its third year. After some two to three years of the input of research, planning, rhetoric, debate and concensus making, the city and county are both well into the output stage of their individual action programs.

I'm sorry your symposium program doesn't include a full day on how to stimulate and strengthen to levels of excellence the local governmental machinery in the wildlands--before development happens.

The political leadership has considered the garbage and kept most of it out. It's not "garbage-in, garbage-out" here. What we have instead is an electorate and political leadership willing to ask the cardinal question like:

Not saying an Ian McHarg plan is great!

But asking, do we want or need it, no matter how good the analysis and planning?

For the last three years, the answer here, locally, has usually been a simple and straightforward "no." And the elected men and women with the courage to vote no on a variety of development proposals have been getting re-elected with an average of 60% of the vote in the last three elections.

I looked over your program--and it has a Chamber of Commerce tone reminiscent of the Eisenhower days of boosterism and pro-growth. It asks how to do it--not whether it should be done at all.

Can you imagine all those guys out of a job if instead of asking for environmental, social and economic impact studies, the local authorities just said no....we don't want any development...no matter how good. Get lost! Why not say it early instead of late. Just think what that money and talent could do if instead it went where it's wanted and needed--like helping clean-up the messes already created in the name of mountain development.

We've got one here...and they've got one at Vail. Forget the malls, bars and boutiques at Vail. Drop over to Minturn or Redcliff for lunch or supper. That's where Vail workers live. Last night you should have gone to Lazy Glen, Basalt, Carbondale, Koa or El Jebel. That's where the Aspen workforce lives.

When the impacts are measured in economic and social terms, an easy way to get a sense of what it's all about is to come to a place like Aspen and Vail....and ask "What's it all about?" But, don't ask the college kids or the PR-types....ask the natives who live and work there...ask the voters...like we do.

If on your Vail visit you promise to check the shanties at Minturn and Redcliff (have your buses go via Battle Mountain), I'll tell you some tales from fabulous Aspen and wonderful Pitkin County--things your research last night probably missed.

Pitkin County provides 25% of all skier days in Colorado. Ninety percent of our skiers are from out-of-state. Sixty percent of our sales-tax take occurs during the four-month ski season from 200,000 skiers. We get forty percent of the sales-tax take in eight months from 1,000,000 summer-type tourists. A skier spends seven days. A summer visitor passes through, stopping for a day or two.

You are summer passing-through tourists. Our net on most of you is minimal...but we're glad you're here. It helps some of the seasonal irrationalities associated with our basic industry. The best times are spring and fall--it's peaceful then--but no one makes his living then either.

Within the last three years our body

politic has done the following:

1. Slowed Growth

We were growing at a 15% to 20% rate in the early 70's. The electorate said stop it. And we have slowed it substantially. No Hilton. Two Ian McHarg plans are dead. Downzoned from 200,000 possible population to less than 50,000. Eight law suits claiming damages of $32,000,000. Owners who thought they could build 1,000 condos woke up able to build one house on each 10 acres. Tough business.

2. Trails and Malls

Last year 250,000 in trails and the same this year--a whole half-million in trails to make using an auto un-necessary for short trips. The city mall program has the same goal. A million may be spent next year to improve and expand the city's mall system.

3. Transit

Stopped the state from 4-laning the highway, and now have a 10 million dollar streetcar application in the final stages before U.M.T.A.--it connects Snowmass with Aspen. In 1976 the city and county will spend some $300,000 on free, year-round buses...for the first time, more than the Ski Corp. spends on its 4-month free ski bus program.

4. Buildings

A $1,000,000 airport terminal opens this fall and a $5,000,000 new hospital opens next fall. Our courthouse renovations will soon reach the $200,000 level.

5. Human Services

We've doubled our police and sheriff departments in those three years. We've added a full-time human resources coordinator, full-time county agent and full-time housing officer. We've doubled the planning department. We've helped finance public health nursing for the first time this year and will give public monies to mental health programs for the first time next year. Between the city and county, we now have two full-time juvenile officers and a major Prevention of Mountain Burglaries Program underway.

I've just gone through several million dollars. That sounds like New York or Chicago--we even have what sounds like an OEO program.

When you put lots of men, women and children at leisure in the wildlands that's what happens!

What bothers me is that no one wants to admit it! It's better pushed under the rug. It dirties the bonanza image of skiing, tourism and man at leisure in the wildlands. It's not nature and peaceful--its wild.

The current county budget totals $4.5 million. Yesterday, I got my first report on the county budget requests for next year. The requests are $1.5 million in excess of projected revenues. I've got 30-days to do the first round of slashing--then the commissioners will join me for the second round. Finally, it'll come into balance--as the law says it must.

But this is the third year we've had to do that. Shortly we're going to do better on our revenue picture. In money terms, our goal is to get 50% of our sales tax in summer and 50% in winter. In conceptual terms, that goal is stated in terms of converting from a pass-through tourism phenomena, yielding 40% of the sales-tax take, to a summer destination resort, yielding 50%--one that is as auto-free as is humanly possible. We've even gone so far as to start studying the possibility of closing Independence Pass to help achieve that goal.

All this adds up in one of our nations oldest and most successful ski and tourism centers in one of America's more spectacular and delicate wildland areas as saying that seasonal "use" can and often is a dangerous and difficult thing because of its off-season "impacts."

Let me close by listing and discussing five of the questions or issues raised by the off-season impacts of skiing.

1. Federal Impact

Should the definition include U.S.F.S. permits for ski area and U.S. tax break for second homes and the year-round effect thereof of land prices on agriculture and employee housing?

(A) Should there be payments in lieu of taxes?

(B) Should federal grants be denied for urban/poverty criteria?

(C) Should there be integrated grants, etc., tuned in to the specific need--not some distant federal criteria?

(D) National recreation access study

(E) Current federal aid criteria are outright discriminatory against ski areas like Pitkin County!

2. Impact Analysis

Developments in most wild area counties find local government lacking in seasonal impact analysis and development control experience. Should the state or someone make an expert strike force available--early enough to be useful?

(A) State do it or state help county do it?

(B) Role of private enterprise--exemplary stance taken by Aspen Skiing Corp. in Washington state.

(C) Role of U.S.F.S., R.C. & D., S.C.S. other federal agencies commonly located in wild area counties?

(D) Fact--all three levels must be in it together--early!

3. Peaking

National holidays and such things as weekend discounts by the airlines contribute to weekend and holiday peaks at the wild area vacation destination. Our new $1,000,000 airport terminal is an example--if our passengers didn't all fly in on Saturday afternoons it could be one-fourth the size. As it is, it's bigger than the one in Colorado Springs.

(A) Seasonal peaking is another problem--our two airlines are overloaded for four months and almost empty for eight.

(B) Holiday peaking is best illustrated by Christmas.

(C) The public costs of peaking include airports, roads, sheriff, hospital, rescue, etc.--they must be sized for the peak and maintained intact in the off-peak! The cumulative effect is costly--in the private sector as well. Restaurant prices have to cover the off-season slack.

(D) Those costs mandate an expensive search for off-peak and off-season fillers. If the search is sensible--fine. If it is panicked and desperate, a place might be willing to "take anything."

4. Can Success Kill?

The last three elections went the way they did because so many voters were convinced success was killing Aspen! I thought Wakiki was dead ten years ago and new high rises are still going up! And for me it is dead, even if it is not for others.

(A) Local success should be defined locally--though more often than not it is defined by investors elsewhere.

(B) Should the number of men, women and children at leisure in a specific wild area be determined:
1) By the local people,
2) By some calculation or carrying capacity
3) By investors, or
4) By the state/federal governments?

(C) What about the Petaluma decision?

5. Who Pays?

Only 200,000 skiers pay sixty cents of each sales tax dollar we receive, while a massive 1,000,000 summer tourists pay only the remaining forty cents. On a per capita contribution basis, you can see why we like skiers. Our summer visitor typically camps, hikes or spends one night and leaves. Many just pass through and stop for lunch, often from the ice chest in the back of the station wagon.

Yet two weeks ago the helicopter bill to find and haul out a dead mountain climber exceeded $3,000. The bill was sent to the family--we hope they pay--or we'll have to. If we make that payment--it'll come from ski season receipts.

We put all taxes paid directly by the Aspen Skiing Corporation and the U.S.F.S. payment in lieu of taxes into our contingency fund.

Does the hiker, camper, boater and other non-taxed sportsmen from outside a county have any responsibility to help pay directly from some or all of the local public costs he causes? If he doesn't pay--who should?

In conclusion--I read your program--and wish I could join you in Vail.

I've rambled around--trying to find a few points that might provide some useful background and a few thought provoking questions to bring to the conference where I'm sure the answers will out number the questions.

Suffice it to say--in Pitkin County the cardinal question today is whether--not how. And if we continue our slow-growth stance--I fully expect we'll soon move from the current emphasis on slowing it to a more positive effort involving how to both keep it slow and still keep it from becoming just another resort for the rich only. But that's another impact--it's time for lunch.

Thank you.

The Developer's View of Ski Area Development

D. R. C. Brown, President
Aspen Skiing Corporation, Aspen, Colorado

The topic of this consortium is "Man, Leisure and Wild Lands" and I suspect that Tom Bell invited me to be here today because the company I represent is dependent upon man with leisure for its economic existence and it operates on the fringes of wild lands, in this instance the White River National Forest. The four ski areas in Aspen cover approximately 8,000 acres. There are over two million acres in the White River National Forest. On a busy day, 18,000 skiers use these 8,000 acres and I would hazard a guess that there has never been a day when there were 18,000 people on the remaining 1,992,000 acres of the national forest. One could assume from this that a ski area offers a recreational or leisure experience to the maximum number of people on a minimum amount of land and that it has little direct impact on the wild lands.

There is, however, a considerable indirect impact and I would like to take you back forty years and describe Aspen in the 1930's. Four hundred people living in town, the Hotel Jerome offering the only tourist accommodation, one grocery store, one drug store, and one hardware store comprised downtown Aspen. The biggest payroll in the community was the Midnight Mine with eight men. The road to Maroon Lake was rough and dusty and saw possibly two or three cars a day during the tourist season. Conundrum Hot Springs averaged less than ten visitors a summer and I have spent a week at Snowmass Lake without seeing another person. This remained pretty much the state of affairs until after the war when the first two chair lifts were built on Aspen Mountain. They had a combined uphill capacity of 400 skiers per hour which was adequate for the demand for the first two or three years, but more and more people came to town, built houses, started lodges and restaurants, and other service businesses and the two lifts had to be supplemented by a third lift and then later a fourth and fifth lift. By the mid-1950's, the town and the demand for skiing had grown to where Aspen Highlands was constructed, a little later Buttermilk and then Snowmass.

The road to Maroon Lake was paved and the campground there so overcrowded that there is now talk of closing it. Conundrum Hot Springs campsite is in equally bad shape. One can find no grass for his horses at Snowmass and somedays it's hard even to find a place to pitch a tent there.

A lot of the new residents of Aspen were people with considerable leisure time. They varied from the retired industrialist who built a half million dollar home on Red Mountain to the college dropout living in a teepee on the wild lands. In addition to these residents, there was a big influx of summer tourists brought here in part by the cultural amenities and in part by promotional programs of the various businesses in town who found they needed more than four months of good business during the ski season to survive.

The resident of Aspen in the '30's had been too busy trying to eke out a living to worry about his leisure activities, but our new residents of the '60's and '70's are most concerned with this aspect of life. They want all the good things associated with the life of leisure, paved bike paths, inexpensive tennis and golf, clean streams to fish in, and moderately priced skiing, and they want the tourist to pay for it. The county's expenditures for these amenities are geared to a growth economy, but public sentiment to a large extent favors a no-growth posture. In effect, the local citizenry is trying to have its cake and eat it too.

The situation in Aspen resembles on a small scale the situation in the entire state of Colorado. Colorado's population has doubled in the past twenty years and most of the people were attracted here by the mountains, the clean air, the skiing, the hunting and fishing and hiking opportunities which abounded in the state. But as more people come here, they tend to destroy the very things that they came here for. The most recent arrival in the state

is usually the most vociferous proponent of a no-growth policy.

The state government has reacted by enacting some fairly stringent land use laws and by using the environmental impact statement as a weapon to deter growth. I have no quarrel with the original intent of an environmental impact statement which was to force a developer to catalogue, consider, and make public all the possible effects of his development upon the environment, but the environmental impact statement has been subverted by certain pressure groups and by state agencies for a purpose far beyond its original intent.

Beaver Creek is a case in point. You gentlemen and ladies are enroute to Vail and no doubt will hear a good deal about Beaver Creek from Vail Associates. Briefly, Beaver Creek is a proposed development near Vail upon which Vail Associates has to date spent over half a million dollars for an environmental impact statement. The project has received Forest Service approval, but at the state level, various agencies criticized the statement as being totally inadequate and the governor has prevailed upon the Forest Service in Washington to place a year's moratorium on any new ski development in the state. As an example of the nit-picking tactics used by a state agency, the state historical society objected to the environmental impact statement on the basis that there had been no inventory of Indian artifacts on the private land involved there.

What it all boils down to is that the development of a new ski area in this state is becoming so involved in red tape and so expensive that it has no appeal to a potential investor. Very few ski areas are profitable ventures now and when a would-be developer has to spend something between a half a million and a million dollars on preliminaries before he even knows whether he can obtain permission to proceed, there is little or no incentive to undertake the development especially when in addition he is faced with regulation of the prices he may charge by the Forest Service. If Beaver Creek gets off the ground, I firmly believe that it will be the last major ski development by private capital ever undertaken in Colorado. If the demand for skiing facilities continues to increase, either there will have to be a change in the existing political climate or it will have to be met elsewhere.

Returning to the original topic, leisure and how we use it is the heart of the problem. Too many people with too much leisure are not compatible with wild land environment.

The State Planner's View of Ski Area Development

Charles Foster, Land Use Planning Consultant
Colorado Department of Local Affairs

Our topic for discussion is Problems of Second-Home Development and Related Land Use Planning. I am not attempting to speak for the State of Colorado on this subject, but will be drawing heavily on past experience as a planning consultant in the Rocky Mountain Region and as County Planning Director in Summit County, Colorado.

Three traditional areas where problems occur as a result of development in a land use system are:

1. Physical constraints
2. Social systems
3. Economic impacts.

In addition, land use problems arising from the system itself need to be considered. These include:

1. Political systems
2. Past commitments
3. Lack of governmental cooperation

Physically most mountain land does not lend itself to development. Ownership is mixed and fragmented. Parcels that were well suited for mine or mill sites or homesteads do not have the same attributes for residential development. Poor soils, extreme slopes, bad aspect, rockslides, avalanches, various geologic hazards, wildfire, and flood danger are so common as to become normal. Altitude seems to intensify most of these problems but is often overlooked. Access can be critical, and considering it an engineering challenge can complicate rather than mitigate the problem.

Decision makers should understand that when you add up all of these factors on a proposed site, the bottom line may tell you: DO NOT DEVELOP. They must learn that an approval to develop is not the automatic reward for preparing all of the required studies, regardless of what they tell us. The studies are to provide adequate information to make a decision which can be either yes or no.

Socially the "natives" or existing population have little frame of reference for the changes that are going to occur as a result of major development. It is extremely difficult for any of us to visualize what X thousand new people or Y thousand new buildings will mean to a community.

There appears to be wishful thinking that the new development will simply create a healthy increase in business activity without altering the existing power structure. As we have witnessed in Pitkin County (Aspen) and Summit County (Breckenridge), the new majority will probably generate massive social, economic, and political change.

A large recreational development requires large numbers of service people, relatively cheap labor, seasonal employment and housing for a broad range of incomes. There is a rapid rate of turnover in the population as old residents move, or are forced to leave, and new residents arrive.

The amount of general turmoil and disruption in the social system will depend upon the population base at the start of development, the rate and period over which development occurs, the magnitude of the project and its location in relation to existing population centers. It will also be very much influenced by the local political system and what steps were taken to predict, time, phase, guide and control the activity.

Economically there has been an assumption that growth, or broadening the tax base, would lead to general prosperity. We talked in terms of benefits and did not consider costs. I see very little change in that attitude in the mountain region. Even though we now have

many bad examples, I can't see that we have learned very much from them.

Developers are optimists. They are always going to sell 100% of the project in 10 years. What happens if only 10% is sold in 10 years? Or if the project is bankrupt in 2 years? We have to look at the alternatives, the best and the worst, and then make decisions.

In mountain counties service costs are high. Obviously the more scattered the development the more it costs for road maintenance and snow plowing, busing school children, police and fire protection, and even trash hauling.

We cannot oversimplify the problem. Development is not all good or all bad. The ski area may be good for a county and the sprawl around it bad. We have to be able to make those determinations and say welcome to the positive and no to the negative.

Local political systems that function adequately under normal conditions are often not prepared to cope with the problems and needs, or the potentials and pressures, of a major development. By the time someone decides that something needs to be done to direct or control the activity, it is probably too late to prevent the worst abuses. Because land use planning appears to be a relatively simple subject--we use land, therefore we know about land use--local officials often assume that they can handle planning problems on the basis of their own past experience. It is difficult to convince those officials that there is a need for professional experience.

While a sewer system must be designed by a professional engineer, land use planning functions may be turned over to an already overworked building inspector or sanitarian. I do not argue with the idea that land use decisions should be made by the local officials. I am only suggesting that the quality of those decisions could be improved if they are based upon facts generated by a planning process conducted by planning professionals.

I think it is necessary here to point out the obvious, giving an employee (or a consultant) the title of planner does not create an instant expert. We need people with a combination of education and experience in land use planning. The universities could play an important role here. There are many good employees who are acquiring experience through their jobs and would welcome the opportunity for education, but cannot travel to the university. What programs can the schools develop to bring planning education out to local governments?

Past commitments can be a major obstacle to land use programs. Commitments can include zoning, verbal agreements, moral or philosophical commitments, and precedents. Whatever the manner in which they were made, commitments are very difficult to change.

In Summit County between August, 1972, and August, 1975, no large rezonings for residential use were approved. This had virtually no effect on residential development (about 3,000 building permits were issued during this period) because prior to 1972 this county of 4,000 residents had been zoned to accommodate a population of more than 100,000. Summit is more the rule than the exception. There are beaver ponds and floodplains zoned for condominiums in too many of our counties.

Verbal, moral, or philosophical commitments are precedents can often be mitigated by changing the decision making process. If facts are required and then used, many of these commitments will be impossible to fulfill. Using good administrative and legal practice would go a long way to solving many of our problems.

There is a general lack of cooperation among local, state, and federal governments. Local government is afraid that big brother will take over and dictate policy. State and federal governments are not convinced that the locals either can or will handle their problems. A cooperative effort is needed that clearly defines each party's roles and responsibilities. Mutually agreeable policies, procedures and regulations can then be developed. To make this idea work, state and federal governments cannot simply pay lip service to the idea but must establish their credibility by their actions.

I know that this is not a new suggestion. What I want to emphasize is that good inten-

tions have not and will not solve the problem. We need a real commitment to good cooperative planning from the state and federal levels to make it work. A first step would be to require cooperative planning on any project where there are public (state or federal) funds or lands or permits required. These would not be authorized until a cooperative planning process had taken place that considered the impacts that would result from the public action. This would not replace an E. I. S. but should bring both the E. I. S. and the local government into the planning process.

In summary, we can go a long way toward solving problems of second-home development and related land use planning by the following actions:

1. Develop education programs that will help local decision makers understand the problems, needs and opportunities.
2. Develop planning programs that will require decisions based upon facts.
3. Develop cooperative planning processes where local, state, and federal efforts reinforce each other in their mutual goal of good land use practices.

Environmental Resource Analysis: Pitkin County, Colorado

Perry J. Brown

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One component of comprehensive land use planning is an environmental resource information base. Environmental data are useful for evaluating the capability of the natural environment to produce land use opportunities and for identifying environmental hazards and unique resources of concern in public policy. For comprehensive land use planning, environmental resource information is combined with social and economic information in the production of a land use plan. Therefore, what is discussed below is not the development of a land use plan, but rather a basic element of comprehensive planning: an environmentally based land use analysis.

In 1972, staff at Colorado State University who were developing a program in regional resource planning began discussions with governmental and citizen leaders in Pitkin County and Aspen regarding comprehensive land use planning. Much of the discussion centered around environmental planning and an analysis of environmental resources. After these discussions and several with environmental planning consultants, it was decided by the Board of County Commissioners to enter into an agreement with CSU to conduct an environmental resource analysis of the private lands within the county. It was determined that the least information had been pulled together for private lands and thus they were to be the focus of inventory and analysis.

The setting in which the study was undertaken is one of environmental grandeur and rapid social, economic, and land use change. Pitkin County is a tapestry of natural qualities. The county's rich and varied natural beauty combines with its historic heritage to produce a character and identity that is unique. The frontier silver-boom atmosphere of the 1880's and the life style of western ranching are set in a landscape of beautiful peaks, forests, and valleys of the Colorado Rockies. This spectacular combination of natural and cultural qualities which developed a unique man-land relationship is now the catalyst for rapid growth. The demand for mountain recreation and the search for a natural refuge away from the crowded urban centers is rapidly changing the character of Pitkin County.

To help the county learn how to control its changing character, an environmental resource analysis was undertaken to meet three major objectives. The first was to develop land use recommendations based on an analysis of environmental resource factors. The second was to provide the county and its citizens with an understandable interpretation of the natural resource factors used to develop the land use recommendations. The third was to provide a dynamic planning tool whose methodology was clear, and one which was adaptable to new information or technology. In meeting these objectives five specific products are identifiable from the study. Several other educational and planning benefits were also realized, but they are of a less tangible nature. The five specific products were (1) a set of single factor resource maps, (2) a composite land suitability map based upon the capabilities expressed in the single factor maps and a set of county goals, (3) a land use decision matrix which enables quick identification of land use constraints and constraint mitigating measures for several potential land uses, (4) a technical report which describes the study methodology and helps in interpretation of the various maps, and (5) continuing involvement with the county to aid in interpreting environmental resource information for comprehensive land use planning purposes. Each of these items is discussed a little later in this paper.

THE STUDY

Procedure

A team of five graduate students was assembled to conduct the study in Pitkin County. Their basic task was to assemble all of the already collected environmental resource information available in many governmental offices and meld this information into a coherent data base. In some cases this involved going beyond the existing information and collecting primary data in the field to fill some gaps. Field checking of the secondary data was also required.

Once the information was assembled it was mapped at a scale of 2 inches equals 1 mile to produce the single factor maps. These maps were then composited based upon a set of given county goals to produce a land suitability map. From these maps and other background information, the other study projects were produced.

Two comments about the utilization of the graduate students are appropriate here. First, they were dispatched to the county and actually lived and worked with the people of the area. This enabled them to develop a sensitivity to the social and political composition of the citizens and to develop ideas and recommendations of concern to the county. Second, the graduate students were given considerable opportunity to develop the project in response to their own ideas and the changing county situation. Within some broad limits they completely administered the project within the county. They developed the contacts to obtain the necessary information, initiated involvement with local public groups, made presentations at public hearings and meetings, and learned to receive both the praise and abuse associated with public activity.

Resource Maps

The single factor resource maps were prepared as the primary display mechanisms for the resource data. They also enable consideration of individual resource elements, and, as new data become available, they enable the modification of one map without the necessity of recompositing which would be necessary for multi-resource maps.

Single factor maps were prepared for geologic hazards, soils, water and hydrology, flood plains, vegetation, wildfire hazard, fish and wildlife, visual vulnerability, and snow avalanche hazards. These resources were selected because of their relationship to public health and safety or because they represent amenities of considerable public interest in the county (e.g., wildlife).

Land Suitability Map

A land suitability map is made from relevant resource factors indicating land capability and social preferences. The suitability map prepared for Pitkin County relied on a compositing of the single factor maps to produce a map which reflected the county goals of insuring protection of health and safety, maintaining open space, maintaining existing and potential agricultural land in agricultural classification, maintaining wildlife populations, and controlling the growth and distribution of development.

The resulting suitability map identifies four land classifications. First, are those lands classed as protected. These are lands which have values or hazards which should not be compromised (given county goals). Such areas as rockfall areas and critical elk winter range are classified as protected. The second classification is non-occupancy lands. These are areas deemed suitable for dispersed and non-permanent use and not suitable for permanent habitation. Steepness of slope was a primary criterion in designation of these lands. Geologic and soils instability and potential for wildfire spread were also considered. Classified third were productive lands. These were primarily lands which had good agricultural potential. Finally, occupancy lands were identified. These are the lands best suited for structural development and long-term occupancy.

Land Suitability Matrix

The land suitability matrix is a planning tool designed to be used in conjunction with the portfolio of single factor resource maps. Basically, this decision matrix associates land use options with resource factors. The matrix indicates the compatibility of each land use category with the different resource factors by indicating whether the factor prohibits, restricts, or does not constrain (allows) the land use activity. Most factors restrict, but do not prohibit activities. Therefore, associated with the matrix is a listing of ways to

overcome the restrictions. These mitigating measures are often engineering and design recommendations.

The decision matrix is valuable because it is easy to use and enables the planner to make quick decisions. From the resource maps the planner can identify limitations on any parcel of land. Then, by consulting the matrix, the planner can identify the activities which are prohibited or restricted, and if restricted, how to overcome the restrictions. With just a little bit of effort the planner can easily respond to a developer's questions and requests by consulting the land suitability matrix.

Technical Report

The fourth product from the study is the technical report which backs-up the other products. Contained in the report is the rationale and organization for the study, sources and methods for data collection, information which could not readily be mapped such as wildlife lists, and an interpretation and explanation of the maps and other data. The technical report is the source book for information on any resource factor.

Continuing Involvement

While the degree of continuing involvement achieved between CSU and the county has been less than desired, communication channels have been kept open during implementation of the study results. Most of the continuing involvement has been in interpreting mapped data and in recommending ways that the information might be utilized in the planning process.

EVALUATION

The environmental resources analysis for Pitkin County was a successful project from several perspectives. First, it contributed substantially to the education of five graduate students in CSU's Regional Resource Planning Program. Second, it was instrumental in strengthening the development of this program. Third, it is being utilized by the county in its land use planning efforts. This use by the county has been very rewarding. The county has been using the study results in preparing land use ordinances and reviewing subdivision and other development requests. It has used the information in other ways also; all contributing to greater comprehensive land use planning for the county.

This project combined several aspects of research, development, and application. While it contained more application focus than many projects, it seems to have contained many aspects of value to the University. Both the direct education of students it provided and the development of classroom examples and case studies were significant project outputs. At times it was difficult working in the highly political environment of land use planning but our general experience has been very rewarding.

The Vail Story

Terry Minger, City Manager
Vail, Colorado

If there had been a Vail just 11 years ago, citizens gazing down from the Eagle's Nest vantage point would have set their sights on a tranquil valley. Perhaps the grazing sheep would have provided the only perceptible movement.

The history that has squeezed itself into this small valley during the past 10 years has been romanticized by ski and travel writers ever since the sheep headed for less inflated pastures.

The ski boom is not the first period of prosperity witnessed by oldtimers in the area, however. In the past, mining and then the railroads brought successive spurts of new activity into the community, then sputtered out either when resources or the public demand became depleted.

Modern historians have often drawn a colorful parallel between the mining and skiing eras in Colorado history. Both brought overnight prosperity and speculation. Some have carried the analogy full circle and prophesized a gloomy end to the ski boom. But, in Vail at least, recent efforts at community development point to a growing trend toward long-term commitments.

Vail pioneers saw a single vision in their early excavations--a first-class ski resort. There were some noisy summers of construction, several energetic winter seasons spent courting converts and gaining loyal friends, and suddenly the vision was real. Vailites could redirect some of their momentum toward building a small community within the larger resort.

In 1966 Vailites instituted municipal government. They elected a mayor, hired a town manager, and incorporated a Town. They took on the responsibility of building a chapel. They hired a full-time physician and started planning for a permanent medical facility. They turned their attention to schools and public recreation facilities--a golf course, tennis courts, ice arena, and summer day camp.

The formation of a centralized marketing agency allowed the community to think of itself in terms of a year-round resort and to encourage convention business.

Increasing numbers of new residents are non-skiers, drawn to the attractiveness of the area as a place to work, to live and to participate in a unique lifestyle.

Even with recent annexations of new land to the Town of Vail, a large portion of the Vail-employed population has spilled into outlying areas. Between 1960 and 1970 the population of Eagle County increased by over 60 per cent. A recent housing study showed the highest concentration of county population in the Gore Creek and Upper Eagle Valley and that more than half of that region's population resided outside the incorporated towns of Vail, Red Cliff and Minturn. What has obviously developed is an untamed suburb stretching to the base of Vail Pass on the east and to and beyond Beaver Creek, the formerly proposed site of the 1976 Olympics on the west.

Lacking all but minimal county controls, the fate of these areas is at the mercy of a developer's conscience. In past months county commissioners have imposed a temporary moratorium on additional connections to the upper valley's sanitation system until overloading problems can be resolved.

Formerly a rural community solely occupied with lumbering, ranching and the dwindling operation of a zinc mine, the county government has accepted a role as arbiter of a growth policy for the sprawling edges of its newest town, Vail, and youngest industry, tourism.

The Town of Vail long ago extinguished any lingering delusions that its architectural controls or other restrictive ordinances might influence similar but self-imposed regulations outside the city limits. In spite of some innovative planning and problem solving, Vail has itself faced continuous civic problems and has as yet been unable to rest

on the laurels of "model" city status.

The need for parking, for an effective mass transit system, for improved utilities systems, for environmental protection and a plethora of other common concerns have nurtured an awareness of interdependence among the various factions in the county, Vail and its neighboring communities. It is from this perspective that the local community is formulating and implementing a new and viable growth ethic.

NATURE OF THE ECONOMY

The Town of Vail and the Upper Eagle Valley economy is almost wholly dependent on tourism and recreation. See Appendices A, B, and C for an analysis of property and sales tax growth over the past five years. The tourism and recreation industry is dominated by skiing and winter sports in that only the winter season utilizes the full capacity of the public and private facilities in the Town of Vail and Upper Eagle Valley. This industry and the related summer construction generate substantial rest-of-the-year economic activity approaching 75% of the winter activity in employment.

The growth of skiing, however, appears to be the driving force behind the town and county's growth. During the past five years a number of relationships have stabilized which suggest that the number of skier days registered during the winter season are a fairly valid indicator of change, a predictor of employment, retail sales and total personal income during the following year.

In summary, skiing is the primary variable affecting the whole Town of Vail/Upper Eagle Valley economy. Change in skiing apparently drives changes in retail sales and in employment (certainly in the part based on recreation employment). Skiing is also the motivator for building more visitor accomodations, and its growth creates more demand for locally employed residents, although that demand may not be met. Also, skiing may be constrained by accomodations capacity. If there are too few accomodations, ski capacity cannot be fully utilized. If there are too many accomodations, skiing capacity will be overloaded and quality will be degraded.

Particularly if condominiums are being marketed as speculative investments, that activity may also become a primary (and very volatile) variable affecting the local economy.

At present, peak accomodations and peak skiing capacity appear to be roughly in balance. Town of Vail skiing capacity is estimated at 11,500 per day. About 15,000 beds are estimated to be available in visitor accomodations.

RATE OF CHANGE

The most accurate and important description of the TOV-UEV is its rate of change. This factor, more than its social composition or its internal relationships, presents the community with its opportunities and its problems.

The Town of Vail has been experiencing an economic boom since 1966, the year that condominium construction and marketing began to dominate much of the community's development. During that period, Vail has become a 'boom' town. ('Boom' is defined arbitrarily as growth at an annual rate of ten per cent per year or more. Our experience indicates that a five to seven per cent growth rate is the maximum a small community can comfortably absorb.) From 1968 to 1973, the following indicators of growth rate have been above the ten per cent threshold which defines a 'boom' situation:

Skier visits	15-18% annual growth rate
Employment (est.)	15-20% annual growth rate
Population (est.)	20% annual growth rate
Retail sales	25% annual growth rate
Total local government spending	15-20% annual growth rate
TOV city budget	20% annual growth rate
County budget	15% annual growth rate
Vehicle registration	20% annual growth rate
Real estate values	20% annual growth rate

QUALITY OF LIFE

Eagle County and the Gore Valley have offered a uniquely high quality of life in the past. This was characterized by easy access

to a magnificently scenic and unspoiled physical environment--from the grandeur of the mountains to the variety of plants and wildlife. This has been supplemented by a cosmopolitan cross-section of people, and unusual but readily accessible amenities of recreation, cultural events, restaurants, boutiques, etc.

This is now perceived by many to be threatened by boom growth and the correlates of boom growth: crowding, dense vehicle traffic, smog, visual pollution, mediocre development and design, increases in municipal and county spending, distorted social structure and ultimately the loss of the small resort-town intimacy.

COST OF LIVING

The cost of living in Vail is now one of the highest of any town in Colorado and the U.S. Housing costs are the biggest single contributor to this high index, and the short supply of family-type housing suggests this cost will continue to rise if the community grows and attracts families. The resort activity bids up food and transportation prices, too, and requirements for public services and facilities raise local residents' taxes further. We have been successful in shifting some of the local tax burden to the guest and visitor through the use of the 3% local sales tax, a lift tax and a developers' recreation tax, thus enabling the municipality to remain responsive during the accelerated growth period.

It should be noted that at a 15 per cent annual growth rate, a quantity doubles in less than five years; at a 20 per cent annual growth rate, it doubles in less than four years. For instance, at current growth rates, the number of people in Vail would double in a little over four years, or 12,500 people by 1978.

As with most boom communities, this sort of growth presents local government with more problems in growth management than opportunities for growth exploitation. Common categories of boom town problems are:

- --effects on adjacent communities and lifestyles outside new-resort town;
- --degraded quality of environment and life;
- --threatened viability of local government;
- --inability of county to provide services in adjacent areas;
- --school crowding and overall lower educational quality;
- --loss of a sense of community and purpose;
- --inflated costs of land, consumer goods and housing.

MIGRATION AND COMMUTING

A noticeable out-migration of Vail child-rearing families has taken place in recent years, presumably caused by housing costs and overcrowding of schools and educational facilities. According to the records of Eagle County School District Re50J, at least 90 families supported by employment in Vail now live in the Red Cliff, Minturn, Avon, Edwards, and Eagle areas who commute to Vail.

SOCIAL CHANGE

An age shift in the County began shortly after the development of the Vail ski resort. According to the 1960 Census, .14% of the Eagle County population was between 20 and 29 years of age; ten years later the same age group made up 32% of the population. This increasingly youthful group is often crowded, campus-style, into inadequate housing. Well-educated young people are attracted by the resort's recreation opportunities and glamour; after one or two years they find themselves under-employed both by level of compensation and by opportunity to be productive, creative, or successful by societal and peer group criteria. Some leave rapidly, others painfully. Early indicators suggest that Vail and Eagle County may be moving toward an increasingly specialized community for the young and the affluent. This presents a major community issue for development policy. Is this desired or healthy?

SUCCESS AND THREATS

The success of the Vail Community as a resort, recreation area and a place to live substantially depends on the same factors, i.e., the physical environment, recreation and cultural amenities, educational opportunities, and cost of living which determine the

quality of life. Crowded slopes, polluted air and water, and inflationary costs, lack of cultural amenities, are direct threats to Vail.

Much more subjective and harder to measure is the possible trend toward a threshold where the rate and quality of growth (particularly in the adjacent unincorporated areas) would move the community from its status as a quality resort--one of the finest in the world--to being another mass production ski area and 'instant' new town. Greater peak use of accomodations and facilities might increase overall productivity, but might degrade the quality of the recreation experienced and therefore the quality of living in Vail.

REDUCED PRIVACY AND WILDERNESS EXPERIENCE

Summer recreation, and the wilderness experience in particular, are potentially threatened by degradation of the environment and the opportunity for privacy and meditation. The rationing of access to camping, backpacking, snowmobiling and cross-country skiing, which may be necessary in the White River National Forest, will not offer present equivalent privacy and wilderness experience to the user. The crowding problem could be just as destructive and acute in Vail's shopping areas, summer recreation facilities, such as golf, tennis and fishing.

WILDLIFE

The inventory of wildlife presently existing in the Upper Eagle Valley includes significant elk herd population, mule deer, and many species of birds, with the red-tailed hawk as the dominant raptor and the blue grouse as the most common upland bird. The impacts of development, construction activity, domestic dogs, and people have generally resulted in big game movement to upper regions of summer and winter range, loss of some natural habitat, and the redistribution of birds where feeding and nesting grounds are disturbed.

Some mitigating design constraints which have been successfully employed to reduce the people, noise, and development impact are:

--minimize blasting during new trail construction;

--restriction of human activities (i.e., snowmobiles) from winter game range;

--town and county lease laws for dogs;

--restriction of human activities from potential elk calving areas during June;

--elimination of predator control practices;

--use of mass transit system for Gore Valley, minimizing vehicular traffic and wildlife vehicle contact.

AESTHETICS

A trend currently observed in Eagle County is that growth in tourism, skiing and intensive recreation land use has made ranching and farming less attractive. Livestock require some tranquility, necessitating closed gates, intact fences, and privacy. If irrigated pastures and grazing livestock are a part of Eagle County's recreation resources (and I believe they are), they appear to be declining. This is particularly a problem since the valley floors, visible from the roads, make up much of the privately owned, developable land in the resort areas of the county. Visual pollution from chopped-up hillsides or cluttered valleys eventually detracts from the quality of the recreation experience which supports Vail and Eagle County.

GREATEST SINGLE THREAT

The greatest single threat to productivity, however, appears to be the possibility that dozens of separate capital investment decisions in the private sector, without county regulation and overall planning, will cumulatively overload the recreation and physical carrying capacities of Eagle County.

For example, this past month, I reviewed a single subdivision for the Avon area, seven miles west of Vail, consisting of 1800 acres and containing 4200 dwelling units. That translates to a potential population of 16,000 people. That figure represents an entire new town in one subdivision development.

The Town of Vail recently conducted a detailed land-use survey which predicts some 80,000 people living in the Town and Upper

Eagle Valley within the next ten years. If our survey is correct, the eastern portion of Eagle County could easily become the largest metropolitan area on the western slope!

DIVERSIFICATION

Diversification of the town and county economy into other sources of income, besides recreation (particularly winter recreation), is highly desirable given the intense specialization of Vail and Eagle County, which are almost totally dependent on recreation and related construction activities. As a result, the town is currently trying to develop a 'second theme' in an attempt to be a more viable and stable community in the future.

VIABILITY OF LOCAL GOVERNMENT

The creation of a town in 1966 provided for early citizen involvement and participation in the affairs and decisions of local government. This public participation was responsible for the rapid transformation of Vail from country club to company town to adolescent community.

The strong orientation toward self-government, culminating in the adoption of a home-rule charter, has enabled Vail to confront its rather difficult and unique problems in a creative way. It has also on occasion sparked sensitive confrontations and debates over divergent development philosophies, and growth and town development policies. For the most part, however, there has existed a single purpose and high degree of cooperation between the town government and the primary developer. It will be interesting to see if this spirit of a common purpose between town and developer continues after the development cycle is completed.

Local government in Vail is now financially sound due, in large part, to the availability of the local-option sales tax. However, subject to the qualification that our economy is based on a one industry community, and if local government assumes more responsibility for preserving the quality of life, government costs may go much higher.

The total cost to all taxpayers of local government facilities and services is rising with growth in the community. A substantial part of these costs are borne by non-residents, through ad-valorem taxes, and we estimate that 75% of the local sales tax is paid by non-resident visitors.

The present level of services supplied by local government seems to be well covered by the existing tax-base and revenue sources. Although this tax-base depends substantially on maintaining the existing level of specialized economic activity, it does not seem particularly vulnerable to a decline in growth rates. It is, however, extremely vulnerable to a decline in the total quantity of visitors and amount of spendable income each has, given the importance of sales tax revenues to the town. The general obligation bonds of local governments appear to be well covered by the present property and sales tax base.

PLANNING AND URBAN DESIGN

For the past few years, the Town of Vail has attempted consciously to develop a series of criteria and objectives consistent with the desires of the community, which will be used as the basic ingredients for the community's urban development. This process is perhaps the most critical, yet elusive, task to be performed in order to determine the community's desires. Although the process and the product are somewhat unique in a recreational new town, they will have applicability to any resort town.

GENERAL SESSION

A Regional Perspective of Problems and Solutions[1]

H. William Welch[2]/

There are no problems in undisturbed nature; there are only solutions, precisely because the equilibrium state is an adaptive state. But in a given area, there is usually more than one possible equilibrium state, and there is no evidence that the natural solution is necessarily the best or the most interesting solution. In fact, it is likely. . .that the symbiotic interplay between man and nature can generate ecosystems more diversified and more interesting than those occurring in the state of wilderness.

Rene J. Dubos

In a real sense problems do not exist. They are abstractions from real problems. The situations from which they are abstracted are messes. A mess is a system of interacting problems. Planning should be concerned with messes. Not problems.

Russell Ackoff

This symposium is concerned with a selection of problems and solutions. The responsibility for the selection rests with the sponsoring organization, the Eisenhower Consortium for Western Environmental Forestry Research. I will not take time to characterize the context within which this selection has been made. It should be evident from review of the program that although a variety of points of view and disciplinary backgrounds is represented there is a pattern and a common thread running throughout the planned discussion. Commitment to the presentation of this particular symposium program was made several months ago on the foundation of a series of commitments made over a period of three years in the shaping and execution of the consortium research program. I will not describe this process except to say that the efforts of the consortium executive committee and appointed committees for long range planning research, and symposium planning were reviewed and acted upon at meetings of the consortium delegates held twice annually.

I particularly wish to acknowledge and express appreciation for the efforts of a much larger group within each of the nine member universities and the U. S. Forest Service which provided substance for this review in the form of recommended research projects and the sixty-five principal investigators involved in the resulting program. The symposium program includes reports by the seventeen of these principal investigators. In the final analysis, it is these individual efforts which will form the basis for judgement of the value of consortium activity.

I wish to emphasize that the symposium objective is to collect and consolidate the views of participants in a critical examination of the current status and a review of future goals of consortium efforts. It is, therefore, crucial that participants actually "participate" throughout the symposium and particularly important that views are articulated and ideas exchanged with constructive candor and with a perspective of the total program in the final session designed for that purpose. It is the responsibility of delegates of the member universities of the Eisenhower Consortium as session chairmen and group leaders in the final session to encourage and sustain an atmosphere of participation and response.

This emphasis on "participation" is essential to the development of a regional perspective of problems and solutions. The realities of the situation which support this statement are

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[1]/ Paper presented at the symposium on Man, Leisure and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

[2]/ President, Eisenhower Consortium and Associate Dean, College of Engineering Sciences, Arizona State University, Tempe, Arizona.

related to the scale of the "symbiotic interplay between man and nature" referred to in the opening quotation from Dubos. When we look at the regional situation we are dealing with a large scale interaction between human activity and the ecosystem. If I give an example of small scale as the interaction of oil shale development with the ecosystem, the implication of large scale may become apparent. Briefly large scale interaction has the following four characteristics:

(a) Aggregation of ecological effects of a multiplicity of human activities interacting with the ecosystem,

(b) Cumulative impacts over extended periods of time which encompass all phases of the interaction,

(c) Propagation of effects through space, time, and the economy and society,

(d) Multiple controlling institutions for geographical subregions, basic natural resources such as land, water and minerals, technological developments which affect resource needs and extraction methods, community growth patterns, exploitation of recreational activities and scenic amenities, etc.

As individuals and as individual organizations, we are, in fact, dealing with abstractions from the real situation of the Rocky Mountain and associated high plains region. As participants in "symposium" and "consortium" activities, we must recognize that we are challenged with the "system of interacting problems" which Ackoff chooses to call "messes." A genuine regional perspective of problems and solutions must include a perception of at least three realities of the situation inherent to all of the abstractions which we identify as problems.

The first of these is what Garret Hardin called the "Tragedy of the Commons." The terminology derives from the concept of herdsmen sharing a common grazing area. The tragedy is that each herdsman as a rational being seeks to maximize his gain by adding one more animal to his herd. The result of overgrazing reduces the benefit of the commons to all. In applying this principle to the world food problem, Hardin has commented that our problem is not a "shortage of food" but a "longage of people."

In our region, the tragedy of the commons is complicated by the problem of multiple use. Grazing is, in fact, one of the traditional uses. The increase in complexity of the situation is literally not quantifiable when recreation, community development, industrial siting mining operations, etc., are added to agricultural uses.

This leads to the second reality which technically is referred to as the "Arrow Paradox" after Kenneth Arrow, Nobel prize winning economist. Arrow demonstrates that definition of aggregate social utility is not in general derivable from a plurality of utility functions based on individual preferences. "Aggregate social utility" implies some type of social consensus. The achievement of "optimum" social consensus by a process which enhances the welfare of some individuals without adversely affecting others is sometimes called Pareto optimization. It is perhaps revealing that Pareto was also credited by Mussolini with the invention of Facism--an obvious solution to the Arrow paradox.

The third reality is that of the "One Alley Scholars." I have taken this terminology from the writings of Chuang Tse who lived in the Third Century BC. In his words:

. . .like a person whose senses function properly each in its own field, or again like the artisans of different trades who are good each in his own line and are often needed. However, without adequate comprehension of the whole, these are but one-alley scholars.

I like this term because it conveys the desired image when one considers the network of streets in a city in their relationship to commerce. No commerce can exist unless the network is used--unless participants "participate" by moving from one alley to another. We need the specialization of the "one alley scholar," the depth of disciplines to cope with the details of large scale regional problems. But without the establishment and use of the network of a participative "community of scholars" comprehension of large scale interaction is impossible.

I am not suggesting that we are delinquent in not having a solution to a problem which was concisely stated over 2,000 years in the past. If we take C. P. Snow literally, we can be encouraged that we have progressed to the Two Cultures level. What I would like to suggest is that we are deliquent if we do not recognize the existence of these realities in a situation of large scale interaction with regional scope and global involvement. Furthermore, it is a fact not a suggestion that whether there be one, two or innumerable cultures, there will be one future and we will make it happen by what we do in the present. The immediate task at hand is to insure that the interaction of those present and the exchange of ideas which takes place during this symposium are fruitful in refinement of our goals, in the definition of problems and the formulation of solutions which will shape the future of our region.

Development in Disarray: Ten Years After PLLRC and "One-Third of the Nation's Land"[1]

Charles Conklin[2]

Introduction

Ten years ago this summer, the Public Land Law Review Commission was organized, in July 1965. Five years ago, in June 1970, the Commission submitted its report entitled "One Third of the Nation's Land"[3] to the President and Congress. Six months later, the Commission went out of existence in accordance with the law that created it. Today, another five years later, there is little legislative action to provide any recognition that the Commission ever existed. Although bills were introduced in 1970 and 1971 by the Chairmen of the House and Senate Committees on Interior and Insular Affairs (both of whom had served on the Commission) and a few other bills have been introduced in the ensuing years, no new statutes implementing the recommendations of the Commission have been enacted.

Planning: The Basic Motivation for Establishment of the Commission

By 1964, when the bill that would establish the Public Land Law Review Commission was introduced, it had become clear to many Members of Congress that what was being followed in attempting to cope with public lands problems was a piecemeal, rather than an overall, integrated approach. Usually the Congress, having virtually abdicated much of the responsibility imposed upon the legislative branch for establishing public policy, simply waited for the executive branch to submit its recommendations, and then acted upon these suggestions one by one, with little or no overall plan.

The weaknesses of such haphazard methods were revealed as each new decision had to be made. The result has been a hodgepodge of laws, regulations, and practices relating to the public lands. Wayne Aspinall of Colorado, then Chairman of the House Committee on Interior and Insular Affairs, began to push for establishment of an overall policy to replace the piecemeal approach, and his efforts eventually resulted in the legislation on comprehensive land use planning that Congress began considering in 1971 and continuing--generally without success--until this day.

Aside from what Representative Aspinall thought was compelling logic for having the Congress enunciate overall public lands policy, there were several matters that had come to a head that seemed to require that something be done.

For one thing, there was a growing dissatisfaction with the Mining Law of 1872. This century-old statute, though it played a significant role both in the settlement of the West and in providing the needs of an expanding industrial economy, was clearly not in accordance with many current concepts. But the Congress could not intelligently consider the complex matter of "locatable" and "leaseable" minerals without a foundation study. It was much easier to say, "Repeal the 1872 Mining Law" than to determine what ought to take its place. Clearly, mineral exploration and production should not cease altogether.

Another situation demanding careful study was the controversy between the legislative and executive branches of government over withdrawals. Here was a chief area where Congress had abdicated its authority. The executive, with apparent legislative approval, had stepped in to provide protection where it was needed from the operation of such laws as the 1872 Mining Law. But no overall policy had been established to guide the executive, who continued to delegate such authority as existed--by the President to the Secretary of the Interior, to the Assistant Secretary, to the Director of the Bureau of Land

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[1] Opening Address presented at the symposium on Man, Leisure, and Wildlands; A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

[2] Staff Director, House Committee on Interior and Insular Affairs, Washington, D. C.

[3] One Third of the Nation's Land: A Report to the President and to the Congress. The Public Land Law Review Commission, June 1970.

Management, and to lesser functionaries operating in the public land states.

A withdrawal, of course, has the effect of suspending the operation of the public land laws for a specific purpose. For example, land may be withdrawn from all forms of mining when it is designated as a national park or monument. But the device has become a public land management tool and is used much more widely by the executive than the example I gave.

There was also, by 1960, a push for legislation to provide for the setting aside of large acreages of the public lands as part of a wilderness preservation system. It seemed to the Interior Committee that such a large dedication of land for one dominant use should first of all be under the control of the policy-making branch of the government, that is, the Congress. It also seemed to the Committee that if this additional piecemeal step was to be taken, some overall study ought to be made leading to establishment of a policy to guide future dedications of the public lands for all purposes. After all, most statutes on the books still provide for widespread disposal of the lands--that is, their transfer into private ownership. Just as the century-old Mining Law seemed out of date, so did this practice of haphazard disposal and piecemeal "permanent" dedication of land.

Accordingly, in 1962, Mr. Aspinall addressed a letter to President John F. Kennedy and invited him to use his good offices to facilitate action on conservation measures affecting public lands. The President acknowledged the need for a broad review of the public land laws and left it to the Congress to determine how Congressional surveillance over executive agency action should be affected. The President took cognizance of the constitutional imposition of responsibility on Congress for the disposal of all government property.

The piecemeal approach continued to be followed, however, as submission of legislation was made to Congress in 1963 and 1964. The Wilderness Act emerged from such submissions. And the Department of the Interior continued to press for an organic act for the Bureau of Land Management patterned after the 1960 Act that governed the Forest Service operations on the public land under its jurisdiction. From this submission finally emerged three separate pieces of legislation--the Act establishing the Public Land Law Review Commission, that providing temporary classification authority for the Bureau of Land Management, and another giving temporary sale authority to BLM. Land thus could be classified either for disposal or retention and, if designated for disposal, sale could take place by a means other than the existing public land laws, such as the homestead laws and Desert Land Act.

These were "temporary" acts, all predicated upon a five-year period at the end of which the Public Land Law Review Commission would go out of existence. Presumably when its recommendations were made, new permanent laws would be enacted to take care of such sales as were to be made in such system of classification of land use planning as might be recommended by the Commission. But a piecemeal classification resulted under the temporary law. By a million acres at a time, in some instances, land was classified for "retention" rather than "disposal", but no further detailed land use plans were developed, the land usually being designated merely for "multiple-use management".

But after 1964, at the same time as the piecemeal approach was followed by the Administration, a careful review of all laws and practices by the Public Land Law Review Commission could proceed.

As I have said, in June 1970, the Commission submitted its report to the President and the Congress. The task that had been assigned to the Commission was a monumental one. It was carried out, insofar as the Commission was able, with efficiency and economy--and with thoroughness. Eighty separate volumes of study were completed to back up the recommendations contained in the report, which was the 300-page document entitled One Third of the Nation's Land.

Planning: What the Commission Said

Perhaps the most significant chapter in the Public Land Law Review Commission report is that on planning future public land use. If the problems identified there by the Commission can in turn be recognized by the Congress and dealt with by the public land management agencies, the many other substantive recommendations of the report will tend to fall into place as they are taken up one

by one in the future.

The Commission said that planning in its broadest terms is "preparation for informed decision-making by the Executive Branch." The Commission found that Congress had not established a clear set of goals for the management and use of the public lands. It also has failed, in many cases, to provide a positive mandate to engage in land use planning. Coordination is lacking among Federal agencies and between them and state and local units of government. The roles of Congress and of the executive branch are not now clear.

Congress, the Commission said, should reassert its constitutional responsibility and enact statutory guidelines requiring land use planning. The multiple-use principle as practiced, with its connotations of dominant use, should receive formal statutory recognition. "Comprehensive land use planning should be encouraged", the Commission concluded. "State and local governments should be given an effective role in Federal agency land use planning. Federal land use plans should be developed in consultation with these governments, circulated to them for comments, and should conform to state or local zoning to the maximum extent feasible...(Regional commissions should be) initiated when possible within the context of existing state and local political boundaries."

The Commission also found state and local planning efforts to be uneven, but generally being poorly developed in those states with large acreages of public lands within their borders. The Commission recommended that Congress provide additional financial assistance to these States "to facilitate better and more comprehensive land use planning".

Planning: What Congress Has (and Has Not) Done

For five years now, Congress has wrestled with the problems identified by the Public Land Law Review Commission and even more forcefully brought to its attention by the growth and energy situations of the early 1970's. The Congress has continued with a piecemeal approach, however, with the broad overview recommended by the Commission lacking. We have HUD planning programs, stepped up highway construction, clean air and clean water laws, coastal zone management, and a national environmental policy act (NEPA). But efforts to enact an overall comprehensive land use planning act, even in a drastically modified form (which we had this year) have been unsuccessful.

I think the major reason for this failure to enact such a law is this: land is defined in the dictionary as "the surface of the earth and all its natural resources." The dictionary also says that land is "ground owned publicly or privately." These two concepts of land conflict when one starts to talk about land use planning.

Although most people today in considering land under the first definition regard it as a heritage to be conserved for all generations, most people today also seem to want to accept the second definition. Land is regarded as "a commodity belonging to us." That is Aldo Leopold's phrase. We are free to buy and sell it and change its character as we choose. Obviously, where this concept of land as private property is adopted by virtually everyone in our metropolitan areas, urban sprawl develops to such an extent that the other definition--"the surface of the earth and all its resources"--seems all but forgotten.

As long as we regard a man's home as his castle, land is subject to abuse. Aldo Leopold also said, "When we see land as a community to which we belong, we may begin to use it with love and respect." Although more than legislation is going to be required to bring about acceptance of the community concept of land, it has been the hope of those sponsoring the Federal bills on land use planning to encourage such a concept at the local and state levels of government.

Public response is at first strongly in support of conserving "the surface of the earth and all its natural resources." As the debate goes on, however, this concept of land tends to fade from view and emphasis is placed on land as a commodity and people begin to worry about having it "taken without compensation" if they are not to be left with unbridled authority to develop it in any way they please.

In the final analysis, all the Public Land Law Review Commission could do was make recommendations. It had no authority beyond that and the next steps were up to the Congress, where implementing legislation was required, and to the executive branch, to the extent policy could be implemented without further legislation. As the Commission, according to law,

"ceased to exist", its job completed by the end of the year in 1970, the 92nd Congress made preparations to convene in January 1971.

There was in the spring of that year readied for introduction in the House of Representatives a bill whose purpose was to take the first step toward legislative implementation of the report of the Public Land Law Review Commission. Since the Congress obviously could not be expected to enact one omnibus bill to cover all the Commission's recommendations, this bill contained overall policy pronouncements and some further implementing language which would establish a land use planning procedure for the one third of the lands that are federally owned. It was expected that other bills would be enacted to carry out further, "second-phase" implementation.

But the Administration, instead of lending its support to the important policy-making function of Congress that President Kennedy so clearly had recognized, again sponsored legislation that would provide an organic act for the Bureau of Land Management--and little more. Under its proposal, wide discretion to acquire and dispose of land would be given to the executive branch and few policy guidelines were indicated. As John Carver, former Under Secretary of the Interior and Federal Power Commissioner, has said:[4/]

> "Perhaps I am overly nostalgic about the level of executive-legislative cooperation achieved during my tenure in Interior, when this great work began. It seems to me...that at both ends of Pennsylvania Avenue...there was respect for facts, willingness to make hard choices and a sense of responsibility for public land stewardship of a very high order. In a way not experienced since, we have infused the idea that users, too, could be conservationists...My cynicism is a product of my disappointment that the final report of the Commission cannot be taken by a Congress and executive branch as highly motivated as in 1963 and 1964 when the Commission was created."

4/ Remarks of John Carver before the Public Land Law Forum, Syracuse, New York, December 14, 1970.

On the Ground: An Inconsistent But Generally Weak Planning Effort

Although I was not able to accompany you, I believe your pre-symposium tour of the last two days reveals what has taken place in one rapidly developing state, which at the same time is a storehouse of natural resources, particularly in connection with the demand for leisure homes and resorts. Efforts in other states, Florida, Vermont, Hawaii, California, and other Rocky Mountain areas, have fallen short of success. It is my belief that there remains a strong need for Federal guidance, not only with respect to the one third of the United States that is held by the Federal government for all of us, but also with respect to the remaining two thirds of the land, because I honestly believe that the Leopold concept of land as a community has to find a reflection some way in our laws and our practices. Federal programs still vary widely. The 1872 Mining Act is still on the books. The piecemeal approach to additions to the wilderness system is still a prevalent method of dedication of public lands for a permanent purpose. And, in the face of increased demand for energy and particularly for use of the public lands as a recreation resource, there has been a failure to look beyond the immediate needs in the way that I think we still should.

I suspect, from hearing your president's opening remarks, that those of you at this symposium are enlightened, but it remains difficult for enlightenment always to prevail when faced with economic realities. I think when Mayor Dodson of Vail left the symposium to "handle a mess", he indicated that he'd come in contact with the reality that perhaps didn't reflect the community concept of land among everything. In addition to Vail there are places like Reston, Virginia, where there was to be a new town with its own industry and everything, as nearly perfect as could be. But when the original developer needed financing, a subsidiary oil company took over and now, although some fine things remain, with the emphasis on making money out of land taking over, the enlightenment that you and I share today often comes out second.

DISCUSSION

R. B. Held, CSU: Where do we stand on an organic act for BLM?

Conklin: The House Subcommittee on Public Lands is hopeful of completing its development of an act by the end of next month. But since the legislation now contains many things in it that are not pleasing to the Department of the Interior, and the Forest Service as well, the Administration may oppose its enactment. I would hate to see a veto because I think the act is needed and I suspect the differences could be compromised in other ways.

Peggy Spaw, Ariz. State Land Dept.: Would you speak briefly to the leasing aspects within the BLM organic act? Is there any new policy on leasing or disposal?

Conklin: There is a revised system of classifying land for disposal under certain narrow criteria which has been recommended by the Administration. I would suspect that very little disposal would take place under that Act, and of course very little takes place now. And yet there remain in existence many laws relating to disposal of the lands or their resources, and until that statutory direction is changed, seemingly the BLM is directed by statute to divest itself of land at the same time this is not clearly the policy reflected by today's thinking. The first phrase of the Taylor Grazing Act under which it operates says in effect, "Pending disposal of the public lands, they shall be leased for cattle to graze on," but although there is every intention of continuing as one of the multiple uses on some of these lands the grazing of livestock, there is also, I'm convinced, every intention of retaining the lands. The new proposed legislation starts to tackle that situation but it makes no overall review of the withdrawal policy which many of the Committee feel is necessary. If you're going to substitute some sort of modern management technique of planning what the land is to be used for, and allocating it for that purpose, these many withdrawals that have been made as I have indicated, with little or no overall policy in mind, should be reviewed. Apparently both the Interior Department and the Forest Service as well as many environmentalists are resisting an overall review of withdrawals because they fear that in the course of a review parcels of land that have been withdrawn might again be opened to mining. In the case of the Department, some bureaucrats have exercised unbridled authority to withdraw when they feel like it and they don't really want any more Federal direction from the Congress if they can have it the way it is. The situation resembles a bank account that you don't have to deposit anything in; you just take out whenever you want to!

D. Badger, OSU: In view of the opposition by many different groups, farm groups, developers, etc., on national land use legislation for both public and private lands, why does Congress continue to insist on national legislation covering both? Why not take at least one step, and maybe you could get national land use legislation on the public lands first?

Conklin: That is a good suggestion, and I think if we could do it we should. But all of you here live in the West, and if you've seen an ownership map of your state, you can see why it is difficult to have effective land use planning for only one kind of owner. Colorado has over 36% of its land managed by either the U.S. Forest Service or the Department of the Interior. Arizona has nearly 45%, and Utah has some 66%. Because of the checkerboard pattern of intermingled land, you really cannot make a very sensible land use planning effort without the inclusion of all land and the cooperation of all the land managers, including private owners and the state and local governments.

I don't think Congress would resist trying to do it for one class of ownership and not for the other, but the bills have been together and they've been separated and they still don't go in the face of such an organized campaign as we had this year against the Federal land use planning bill, which dealt generally with the non-Federal lands. Although what was proposed was a grant program similar to other types of Federal aid, people became so convinced that this would be a Federal zoning program and take away land without compensation we got strange reactions, as the following examples from letters we have received indicate:

> "The Federal Land Use Control Bill was defeated last year. Why in the world is it back again with built-in bribes, as H. R. 3510?"
>
> "There are so many bureaucrats with nothing to do but 'plan' ways to get control of the hard-earned property of others! Turn those harrassing bureaucrats away from the public trough. Give them a taste of the self-

sufficiency of laissez faire capitalism, in contrast to being leeches on the production of others."

"It is time to repeal NEPA. Get rid of the Noise Control Act, Water Pollution Act, Clean Air Amendments Act, Coastal Zone Management Act, Flood Disaster Protection Act, and all other measures designed to take away my right to do as I see fit with my land."

"This fact should be well known to you that all dictatorships control the land and the people own none! Russia, Red China, in Hitler's day and Mussolini's."

Final Question: Is there any difference between House and Senate handling of the land use bill?

Yes, Although we started from approximately the same place, the Senate bill now is probably a stronger bill than we thought might be acceptable to the House. It also has energy siting provisions in it. Some members of the House Committee believe in such provisions too, and would like to have had them in our bill, but the jurisdictional lines among committees in the House are such that our Committee does not have the same responsibilities that the Senate Interior Committee does. I understand that the Senate Committee may consider its bill next month with the site location detail in it, the idea being first of all that siting provisions are needed, and secondly, that since the Administration favors such provisions, including them may make the bill veto-proof (the Administration will do almost anything in the name of energy--except sign a strip mining bill!).

SESSION I

THE NATIONAL OUTLOOK FOR LEISURE HOME AND RESORT DEVELOPMENT THROUGH THE SEVENTIES

Chairman: Robert E. Dils, Dean
College of Forestry and Natural Resources
Colorado State University

Coordinator: David B. Thorud, Director
School of Renewable Natural Resources
University of Arizona

Session I focuses on the national outlook for the future sales, development, and use of leisure properties, with directed focus on the Consortium region. Speakers are realtors, market analysts, planners, and an airline executive whose company specializes in the development and promotion of package tours to concentrated recreational resort developments in the Rocky Mountain region. Speakers explore the existing market for leisure properties--who are the buyers and users, and what are the future implications of more competition for land use in a fragile environment.

Future Demand for Recreational Properties[1]

Richard L. Ragatz[2]/

Abstract. The purpose of this paper is to project future demand for various types of privately owned recreational properties by regional location in the United States. While long-range demand may appear optimistic, several important social and economic parameters may limit full realization of the following projections.

INTRODUCTION

During the past few years in this country, as throughout most of the Western Hemisphere, a widespread and complex market has developed for privately owned recreational properties. Included in this market are vacant recreational lots, single-family, detached leisure homes and resort condominium units. Motivations for the purchase of such properties vary as greatly as the variety of projects offered. For instance, one family may purchase a $1,995 vacant recreational lot in New Mexico simply for long-term speculation, while another family may purchase a $150,000 resort condominium unit at Lake Tahoe for intensive use and as a tax shelter.

The future market for these recreational properties is equally complex and subject to major shifts in demand according to economic conditions and societal changes. A severe deficiency exists in an adequate data base for describing even the current situation. Definitional problems, insufficient nationwide census information, and so forth, work together to prevent a clear portrayal of the market. These limitations become more exaggerated when attempting to project future demand.

Numerical projections are certainly subject to question. Since recreational property is not a basic necessity such as food, clothing, and primary lodging, it is open to major changes in demand. Obviously, demand increases during periods of economic expansion. The energy crisis will certainly affect the market, but it is impossible to determine to what degree as of this writing. Thus, all numerical projections made in 1975 will be subject to many future unforeseen influencing parameters. Readers are cautioned to remember the above limitations while applying these projections. This is especially true in light of the present economic problems facing the United States.

The following projections are taken from part of a study conducted during 1973 and 1974 and funded by the Council on Environmental Quality, HUD, and the Appalachian Regional Commission. The overall study was conducted by the American Society of Planning Officials, in cooperation with the Conservation Foundation, the Urban Land Institute, and Richard L. Ragatz Associates, Inc.

METHODOLOGY

The number of households projected for the four census regions in 1975, 1980, and 1985, were taken from data presented by the U.S. Department of Commerce, Bureau of the Census, in Demographic Projections for the United States, published by the U.S. Government Printing Office in 1973. It should be noted that limitations exist even in this initial step. While the margin of error for projecting households (at least through 1985) is considerably less than for projecting total population, limitations still occur. Such variables as societal changes in divorce and marriage rates, regional shifts in population distribution, economic recessions, and so forth, influence the rate of household formations.

1/ Paper presented by Dr. William Clark, Assistant Professor, Department of Urban Planning, University of Oregon at the symposium on Man, Leisure and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

2/ President, Richard L. Ragatz Associates, Inc. Consultants in Vacation Housing and Recreational Communities, Eugene, Oregon.

Propensity for future ownership of recreational properties was obtained primarily from an unpublished nationwide survey conducted for Richard L. Ragatz Associates, Inc. as part of a study for CEQ and HUD by the Opinion Research Corporation of Princeton, New Jersey between September 8 and October 10, 1973. The survey was conducted on a personal-interview basis in the homes of respondents. It involved a weighted sample of 7,190 households throughout the United States. Questions concentrated on status of present ownership and future plans to purchase recreational properties by date and type of property.

These numerical projections were then reconsidered in light of several other nationwide projections of future demand for recreational properties. Projections considered included those made in an unpublished study concerning future housing demand for the National Association of Home Builders in 1973; a study made by a private research firm in 1971; and an unpublished study of 9,231 Bell Telephone users, conducted by AT&T in New York in 1965. These projections are less detailed in regard to type of property or future date and were used simply as benchmarks to ascertain whether projections derived in the study by the Opinion Research Corporation were reasonable.

The four sets of projections were then integrated, with emphasis placed on the more recent and better designed Opinion Research Corporation survey. Integration involved some degree of subjective interpretation based upon knowledge and insights gained from the research involved in preparing the overall report for CEQ and HUD. Though discrepancies between the various sets of projections were surprisingly small, final projections are somewhat more conservative than the others. It was felt that persons tend to be overly optimistic about their future plans for purchasing recreational properties. In many instances, such plans are never realized and the discretionary income is allocated to other household items. Finally, numerical projections are reinterpreted in a subjective discussion concerning the effect that changing economic, ecological, and cultural parameters could have on the markets.

NUMERICAL PROJECTIONS

Table 1 presents future demands in the United States for various types of recreational properties for 1975, 1980, and 1985. Estimated figures are also presented for the situation in 1973. Projections are provided for all recreational properties (as an aggregate); vacant recreational lots purchased only for for speculation or investment purposes; vacant recreational lots purchased for the purpose of building a future leisure home; recreational lots occupied by a single-family, detached leisure home; and resort condominium units. Absolute and relative figures are included in the table. Table 2 presents absolute projections for the same types of recreational properties on a regional basis.

In 1973, it is estimated that about 5,700,000 households (or about 8.5 percent of the total) in the United States owned one of the four primary types of recreational property. Most of these properties (over 3 million) represented a recreational lot occupied by a single-family, detached leisure home. The type with the lowest frequency was the resort condominium (numbering roughly 200,000).

It is projected that by 1985, the number of recreational properties will increase to almost 12 million, which means that about 14 percent of all households will own such property. Most significant increases will occur between 1980 and 1985 as the post-World War II baby boom reaches the time in the family life cycle when propensity for purchase of recreational property is greatest.

In terms of the type of recreational properties to be demanded, it appears that the least increase will be realized in the demand for vacant recreational lots, especially those purchased primarily for speculation or investment purposes. Most significant increases in demand will be for recreational shelter, both single-family, detached leisure homes and resort condominiums. In absolute terms, the greatest increase will occur in the detached units (from 3 million to almost 7 million). In relative terms, the greatest increase will occur for resort condominium units; increasing more than three-fold from .3 percent to 1.0 percent of the households.

In review of recent events in the market for recreational properties, it would appear that the projections for resort condominiums may still be severely understated, especially in relation to the other types of properties. It also appears, as will be noted in this paper, that all the projections probably are overly optimistic in light of recent occurances in this country.

On a regional basis, as shown in Table 2, a wider dispersion of ownership will occur, partly due to changing regional propensities for purchase of recreational properties. For instance, in 1973 it is estimated that 24.6 percent and 25.5 percent of all recreational properties in the United States were owned by

households in the Northeast and North Central regions. By 1985, it is estimated that these percentages will be 21.5 percent and 23.0 percent, respectively. On the other hand, figures in the South and West will change from 29.9 percent and 20.0 percent in 1973 to 32.0 percent and 23.5 percent in 1985, respectively.

It is anticipated that relatively little increase in demand will occur in the Northeast for recreational lots purchased only for speculation or investment purposes (an additional 74,000 lots). At the same time, the most significant growth for this commodity will occur in the West (an additional 320,000 lots). Such conditions reflect availability of land, saturation of the market, and a variety of other reasons. Similar regional trends are projected to occur for recreational lots purchased for future building of a leisure home, although the variations are less severe. For the latter type of recreational property, most significant increases in absolute terms are anticipated in the South and the least amount of increases in the Northeast.

For single-family, detached leisure homes, the greatest absolute growth will occur in the South and West, since it is projected that both these regions will realize about one million more new units by 1985. Such increases will be between 700,000 and 800,000 in the Northwest and North Central regions.

The anticipated regional growth patterns for resort condominium units will be even more exaggerated, with very significant increases to occur in the South and West. Such patterns again reflect market saturation, availability of land, lack of prior consumer opportunity, and other factors.

INFLUENCING PARAMETERS

It is difficult to arrive at any concrete conclusions about future demand for recreational properties. A series of numerical projections have been made for 1975, 1980, and 1985 by family income and age of household head. However, these projections are based upon opinions derived from feelings expressed by potential consumers in 1973. They are based upon responses from persons in the demand sector without the aid of insight offered by persons actually supplying the markets. The projections are also made in isolation from a whole set of subtle, changing, cultural and societal values in the country.

It appears the realization of short-term demand will be definitely affected by a series of issues which may or may not be in evidence several years from now. Such current crises facing the recreational land and leisure housing industries as a bad public image, unavailability of financing for the developer and consumer, and exorbitant costs of building supplies, labor, etc., may continue to exist in the future. However, these items all appear rather inconsequential when assuming a long-range perspective of the markets. For instance, financing rates and availability have, traditionally, changed drastically within short periods of time; the negative image could be reversed if and when the industry begins to monitor its members; the costs of building supplies and labor have always fluctuated according to the economic climate of the country.

However, when stepping back and considering long-range future markets for recreational properties, a somewhat more complicated picture is portrayed, because the influencing parameters become more hazy and confusing and, simultaneously, more critically influential.

Many long-range indicators portray an optimistic future for increased demand. For instance, it is anticipated that leisure time will increase and, most significantly, will be available in larger aggregations such as three-day weekends, extended weeks, or even months. Retirement will be possible earlier, and older people will live longer. They will also have more monetary resources available to them, be healthier, and more acquainted with recreational and travel experiences from past participation.

The post-World War II baby boom will be reaching the age in the 1980's when propensity for purchase of recreational properties is highest. Interest in nature, ecology, the natural environment, and participation in so-called "healthy and youthful" outdoor recreational activities will continue to improve as the Interstate Highway System is completed. Thus, most predictions for so-called opportunity and facilitating factors portray a situation where more and more families will be able to purchase recreational properties.

For instance, the uncertainties of the international situation complicate projections for future personal income in the United States. If the more underdeveloped nations of the world begin to demand a more equitable distribution of wealth and resources, either through political or economic coercion, negative effects will most certainly be realized on the GPN of this country. This in turn could affect employment rates and median family

income. Also, an increasingly larger segment of the population in the United States may perceive the work ethic in a different light in the future and be less motivated toward higher incomes and associated availability of goods and services. Fewer persons might actually have the anticipated discretionary income to buy a second home for seasonal-recreational purposes--at least in the manner in which most leisure homes are being produced today.

The immediate concern with ecology and preservation of a quality environment does not appear to be a passing fad, but rather one that will continue to increase in the future. Increasing numbers of communities and states will consider no-growth or limited-growth policies. Local decision-makers will become more sophisticated in dealing with the land development process and will use criteria to determine what type of new land development will prove most beneficial to their community in the future. No longer will the only criterion be the possibility of increased contribution of immediate return to the property tax base, but rather more subtle criteria will be used such as costs and benefits related to social, environmental, and long-term economic impacts.

Quality land close in to population centers will become less available and much more expensive. More of this land will be maintained in the public domain or placed under much stricter and more rational public control. Land in marginal productivity might have to be used for support of agriculture and other primary industry in order to satisfy world demands for a more equitable distribution of wealth and resources.

The energy crisis appears to be real and again, not just a temporary concern. As previously noted, it most certainly will affect the future market for recreational properties. In the foreseeable future, it seems likely that certain segments of society including legislators and the public at large will question the morality and rationality of allowing some persons to own and develop property simply for seasonal-recreational purposes. The question will most certainly be raised as to why a select group of people should be able to afford two relatively expensive homes when a much larger segment of society has never been able to realize the government's 25-year-old goal of a "safe and decent" living environment.

The current income tax practices which in some instances make owning a condominium or rental leisure home a very profitable venture are related to the inequitable distribution of wealth in this country. It would appear that public pressure will influnce additional restrictions to be made by SEC and IRS in regard to these allowed tax benefits and write-offs.

A whole series of additional changes could occur in the cultural context of our society which might affect the future markets for recreational properties. It seems a growing segment of the population is less motivated by status attainment and fee simple ownership of real property. Currently restricted to the youth, there are indications that such changes are slowly penetrating other age-groups. At the same time, other more subtle factors appear to be gaining in popularity. Included are such difficult to define items as sense of community, togetherness, sharing, family, concern with nature. These factors do not necessarily imply changes in demand for recreational properties, but perhaps a change in the type of property which is of interest to the potential consumer.

Related to these comments is the fact that our society seems to be ever-increasing in its demand for variety, flexibility, and desire for new experiences. More attractions are becoming available for the utilization of leisure time, and the public seems to be responding in terms of buying these new concepts and commodities. Travel clubs, camping clubs, and new concepts in land ownership all appear to be increasing in popularity. The opportunity to experience a variety of recreational activities is attractive to greater numbers of people. The offering of such opportunities at relatively inexpensive costs has definite implications for the recreational land industry as we know it today. It would appear that the singular alternative of the fee-simple, single-family, detached house on a half-acre lot in a location with one limited set of recreational activities will encounter more and more consumer competition in the future from other forms of recreational pursuits.

In summary, the combination of past trends and the converging of time, money, and attitude imply a growing market. However, certain unpredictable, long-range factors, such as redistribution of wealth and a heightened energy crisis, may dampen the possibilities for an ever-expanding, high-volume, high-profit market.

Table 1

DEMAND FOR RECREATIONAL PROPERTIES
IN THE UNITED STATES[1/]

Type of Property	1973	1975	1980	1985
Number of Households	67,430,000	70,080,000	77,000,000	84,000,000
Households Owning Recreational Property	5,732,000	7,008,000	8,855,000	11,760,000
Percent of Total Households	8.5	10.0	11.5	14.0
Households Owning Vacant Recreational Lot for Speculation/Investment	877,000	1,051,000	1,155,000	1,680,000
Percent of Total Households	1.3	1.5	1.5	2.0
Households Owning Vacant Recreational Lot for Future Building	1,416,000	1,752,000	2,310,000	2,520,000
Percent of Total Households	2.1	2.5	3.0	3.0
Households Owning Single-Family, Detached Leisure Home	3,237,000	3,855,000	5,005,000	6,720,000
Percent of Total Households	4.8	5.5	6.5	8.0
Households Owning Resort Condominium Unit	202,000	350,000	385,000	840,000
Percent of Total Households	.3	.5	.5	1.0

1/Estimates for 1973 and projected for 1975, 1980, and 1985.

Table 2

DEMAND FOR RECREATIONAL PROPERTIES
WITHIN THE UNITED STATES

Region	1973		1975		1980		1985	
Number of Households								
Northeast	16,075,000	(23.8)	16,470,000	(23.5)	16,600,000	(21.5)	17,500,000	(21.0)
North Central	18,451,000	(27.5)	19,060,000	(27.0)	20,500,000	(26.0)	22,000,000	(26.0)
South	20,825,000	(30.8)	21,870,000	(31.0)	25,000,000	(32.5)	28,000,000	(33.0)
West	12,079,000	(17.9)	12,680,000	(18.5)	16,500,000	(20.0)	17,000,000	(20.0)
United States	67,430,000	(100.0)	70,080,000	(100.0)	78,600,000	(100.0)	84,500,000	(100.0)
Households Owning Recreational Properties								
Northeast	1,410,000	(24.6)	1,672,000	(23.9)	1,900,000	(21.6)	2,523,000	(21.5)
North Central	1,462,000	(25.5)	1,747,000	(24.9)	2,005,000	(22.6)	2,715,000	(23.0)
South	1,712,000	(29.9)	2,079,000	(29.7)	2,715,000	(30.7)	3,777,000	(32.0)
West	1,148,000	(20.0)	1,510,000	(21.5)	2,235,000	(25.1)	2,745,000	(23.5)
United States	5,732,000	(100.0)	7,008,000	(100.0)	8,855,000	(100.0)	11,760,000	(100.0)
Households Owning Vacant Recreational Lots for Speculation/Investment								
Northeast	199,000	(22.7)	225,000	(21.5)	239,000	(20.5)	273,000	(16.0)
North Central	240,000	(27.4)	241,000	(23.0)	275,000	(24.0)	337,000	(20.0)
South	249,000	(28.3)	289,000	(27.5)	315,000	(27.0)	560,000	(33.5)
West	189,000	(21.6)	296,000	(28.0)	326,000	(28.5)	510,000	(30.5)
United States	877,000	(100.0)	1,051,000	(100.0)	1,155,000	(100.0)	1,680,000	(100.0)
Households Owning Vacant Recreational Lots for Future Building of Leisure Home								
Northeast	298,000	(21.0)	350,000	(20.0)	417,000	(18.0)	427,000	(17.0)
North Central	357,000	(25.2)	418,000	(23.9)	489,000	(21.0)	558,000	(22.0)
South	461,000	(32.6)	566,000	(32.3)	760,000	(33.0)	860,000	(34.0)
West	300,000	(21.2)	418,000	(23.8)	644,000	(28.0)	675,000	(27.0)
United States	1,416,000	(100.0)	1,752,000	(100.0)	2,310,000	(100.0)	2,520,000	(100.0)
Households Owning Single-Family, Detached Leisure Home								
Northeast	864,400	(26.7)	1,015,000	(26.3)	1,162,000	(23.2)	1,548,000	(23.0)
North Central	813,400	(25.1)	933,000	(25.8)	1,240,000	(24.8)	1,600,000	(24.0)
South	926,300	(28.6)	1,115,000	(28.9)	1,520,000	(30.4)	1,982,000	(29.5)
West	632,900	(19.6)	732,000	(19.0)	1,083,000	(21.6)	1,590,000	(23.5)
United States	3,237,000	(100.0)	3,855,000	(100.0)	5,005,000	(100.0)	6,720,000	(100.0)
Households Owning Resort Condominium Units								
Northeast	48,200	(24.0)	82,000	(23.5)	82,000	(21.0)	175,000	(21.0)
North Central	61,800	(30.5)	95,000	(27.0)	101,000	(26.5)	220,000	(26.0)
South	65,800	(32.5)	109,000	(31.0)	120,000	(31.5)	275,000	(32.5)
West	26,200	(13.0)	64,000	(18.5)	82,000	(21.0)	170,000	(20.5)
United States	202,000	(100.0)	350,000	(100.0)	385,000	(100.0)	840,000	(100.0)

1/Estimated for 1973 and projected for 1975, 1980, and 1985

Assessment of the Regional Market for Each Category of Development[1]

J. J. Collins[2]

The topic that I have built my talk around is more specifically directed toward what we perceive to be the trends in marketing real estate in this area. Dr. Clark's paper laid the groundwork for much of what I have to say.

What I'd like to do is give you an overview of what has happened in this business in the last 10 to 15 years. First, we must ask ourselves a question: Is there a demand, in fact, for the continued use of this recreational experience that Dr. Clark mentioned? I think the answer is fairly simple, but its implications can be rather far-reaching. The answer is definitely, yes. As an example in our 1973-74 and 1974-75 ski seasons, we saw increases in this demand in the vicinity of 20%. The implication that's interesting is that, during this 2-year period, the economy was in its worse condition since the end of World War II. Prices of petroleum products, primarily gasoline and aviation fuel upon which we are completely dependent here, were either soaring or the product was completely unavailable. Yet, we saw a tremendous increase in people coming from all over the country to Vail, Colorado. Why?

If the basic American wage earner, salary earner, or professional man, is struggling to make a living for 50 or 51 weeks out of the year, and he's got the most rudimentary means of enjoying himself for a 1- or 2-week vacation, then he's evidently going to do it, and the American credit system, fortunately or unfortunately, allows him to. The ads that recommend you think of your Credit Card as money perhaps sustain much of this increase. But, the important thing to realize is the demand is there now, the demand is going to increase, and people will do their utmost to enjoy themselves for at least 1 or 2 weeks, if they can afford it, out of the year.

Another reason why is the increased pressures in the urban environment--pollution, high crime rates, high rents, increased regulation, and so on and so forth. People want to get away from that to revitalize themselves. Thoreau's saying has been popularized in recent editions of large posters: "In wildness is the preservation of the earth". Wildness, be it here in Vail, Colorado or in the Wind Rivers Wilderness Area, seems to be the impetus that brings him here; he has to get away for at least a while; he has to do something other than live in that urban environment.

The challenge for people in the business of marketing the real estate product is: How do you preserve this experience, and yet offer it to the consumer without destroying it? This is the nut that we have to crack. You discussed Beaver Creek with one of our associates, Dave Mott, yesterday: Beaver Creek is a classic example of what to do. I have to get into the trends now that affect that challenge, and I am assuming again that the demand is there and that it will continue to grow.

There are two basic factors, in my opinion, that have greatly affected the development and marketing of the recreational experience. I'm going to lump them into two huge categories, so please bear with me. One of them has to do with the affordability of the experience--the financial considerations. The other has to do with the preservation of the experience--the environmental considerations. Whereas 10 or 15 years ago the two might have been

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[1] Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

[2] Real Estate Sales Manager, Vail Associates, Vail, Colorado 81657.

viewed by the common man in the business (or not in the business) as always completely separate unto themselves, I think today those two are by no means separate. If anything, they are almost completely dependent one upon the other. You cannot consider the development of a piece of property such as Vail, or a small subdivision, or what have you, without considering the environmental implications.

FINANCIAL CONSIDERATIONS

From 1960 to about 1972, somewhere in that area, we had what is considered to be the boom period in real estate development--not only in resorts, but throughout the economy. The government was pushing for construction of 26,000,000 new units in that 12-year period. It was characterized by what we called "easy money". The banks, the S&L's, and thrift institutions were loaded with deposits, and consequently the mortgage market was very strong. Interest rates were low. Incomes were good. Real incomes, not just the amount of dollars, but the buying power of those dollars, increased in some income brackets, mainly in the $10,000 to $15,000, and the $15,000 to $25,000, five-fold in that 12-year period. That was the bread and butter market to the three million lot buyers that Dr. Clark mentioned in his paper, and to the condominium buyer and to the single-family detached-home buyer. Real expansion of spendable income was literally staggering. Then leisure time came along, the 4-day week, the demand for more recreation time. This availability of income and increased leisure time spawned the development of recreational amenities and resorts, in all parts of the country and all parts of the world. People were able to take advantage of them, and the developers were in a very profitable business.

Then came 1973. The positive aspects of the economy had reached their peak, and within a period of 6 months an awesome change took place. The easy money not only became tight, it disappeared altogether. It didn't dwindle, it just plain vanished. The great increase in real spendable income disappeared, and consequently the market dried up. Prices, inflation, and taxes went higher. As a result there were thousands of unsold units on Florida's "Gold Coast", and thousands of unsold units in the Rocky Mountain area here. There was no money to buy them in the institutions; there were no buyers in the market. We had come to the classic "crunch". Money was gone.

What has that experience taught people in my business? It has taught us several things, but I'd like to narrow it down to one example. Essentially, the financial problems we ran into forced us to design a product that was marketable continuously, a market that perhaps is not going to have, or definitely is not going to have, the amount of money it did in the last 5 to 10 years. The market then was designated to supply single-family detached-housing on a half-acre lot, whole-unit condominiums, recreational second-home sites for speculation or construction. That market has been severely restricted, and though it will recover to a certain extent, the important thing is that new products have come out of that experience.

One of these trends, which we're just beginning to see here in Vail, is the concept of time sharing or as Vail Associates terms it, "Interval Ownership". The concept goes back to the Club Hotel Corporation developments in the south of France, the southern French ski resorts, and to the Riveria. The SEC has restricted the market regarding the securities nature of offering real estate. The IRS has constantly whittled away the tax shelter advantages of buying resort or second-home real estate. Then finally we had inflation and recession put in jeopardy the amount of discretionary income a potential buyer can spend. It's a classic example, both of discretionary income that a potential buyer can spend, and of the seller adapting himself to what the buyer can afford.

Fifteen years ago a high-rise building was divided by spatial parameters into condominiums. We actually got a map that showed the definitions and linear footage in the building. What has been done in Interval Ownership is take that spatial orientation in the condominium, and put it into a time frame. We split the year into 52 weeks, remove two weeks at the low periods of each season for maintenance, overhaul and upkeep, and then offer the other 48 weeks primarily as single weeks or groupings of three weeks, for instance the Christmas period, and five weeks in some of

the low-season periods. We price them accordingly, and put them on the market. That $65,000 condominium can now be purchased for anywhere from $800 for a summer week to $3,800-$4,500 for a winter week during the ski season.

The market place is demanding lower-priced units with the same amount of conveniences, and this seems to be one of the means that will satisfy the demand.

ENVIRONMENTAL CONSIDERATIONS

During that same time period, the last 10 to 15 years, I don't think many people in the business knew the words "environment", or "ecology", or "ecosystem". Now, they are not only household words, they are a cause that's been picked up and carried, hopefully not too late, to the position in our areas of concern where it ought to be. This has had a definite influence on trends in the real estate business.

We now have a different set of planning parameters. The practice used to be to obtain a piece of land, lay down your grid work, carve up your streets, worry about water and sewer systems, trash removal, proper paving and so on, stick lot number signs on the lots, put up a mobile home, and start selling. Today, however, the process is similar to what my company has taken on with the development of the Beaver Creek ski area.

I think you will find that most people in the business are very capable and very concerned about picking up that--let's call it a "burden"--simply because it is essential to our survival. And there's good reason for it. It solves part of that challenge I mentioned earlier. How do we preserve what we're offering, and market it effectively without destroying it? Proper planning must be legislated, and those developers who are capable of picking up the challenge will be the successful ones. Planning Authority, for instance, has done a magnificant job of legislating pollution abatement in a difficult situation. Hopefully, we won't have to get into that situation if the proper planning constraints are placed upon developers now. I think there's a much greater concern, on the part of good developers, for protection of the environment gets into such things as density controls: Where are the people going to come from? Where are they going to be housed? How are they going to be moved about the area? What population will the area sustain on any given day? How much work will have to be done to prepare the area for this influx? Because this environmental factor that has been placed upon the developer involves money, we have those two separate entities of 15 years ago coming together very closely: the environmental and the financial considerations.

Of all the trends in the business today, I think this greater awareness of the relationship between financial considerations and environmental considerations it the greatest single factor in the resort real estate marketing business.

The one thing I was looking for was a windup to this presentation, and I found it in the letterhead of the Eisenhower Consortium: It's the saying that "nature to be commanded must be obeyed".

Measuring the Consumer Demand for Use and Development of Leisure Properties[1]

Maurice L. Kelley, Jr.[2]

Since I'm an advertising and marketing man in the airline industry, it will probably not surprise you to learn that my premise is that the use and development of leisure properties will depend to a large degree on the continued vitality of the air transportation industry. Distance and time are perhaps less important in the development of an area like this one, but driving vacations to Hawaii, for example, are minimal at best.

So rather than give you a highly statistical talk on consumer demand and usage figures, I thought, as the only active member of the airline fraternity on the program, that I would sketch the overall industry outlook from my vantage point--with specific attention to marketing to leisure and resort areas.

First of all, the airlines are not in particularly good shape to invest a lot of money or time in new market development of any kind at the moment. In most cases, airlines are competing for existing business.

Consumer demand for air travel has not been particularly strong this year. For the first seven months of the year, airline industry traffic as measured by revenue passenger miles was down about 0.6%. Economic uncertainty, inflation, unemployment and other factors that you're all aware of have resulted in a softening market--especially for leisure travel. (An exception is Colorado where our ski business increased over 60% in 1975) Further, it was the lower priced programs which suffered most. People seem more interested in value (in terms of total package offered) than ever.

Based on the economic recovery, which we sincerely hope will happen finally, the industry is predicting a flat 1975 with a return to modest growth predicted for 1976.

The profit picture is even less bright.

The U. S. airline industry lost $164.2 million in the first quarter of 1975 compared with a $4.8 million profit in the first quarter of 1974.

This improved in the second quarter, but we can't even hazard a guess at the total industry profit picture for the year 1975 because we don't know now what added costs we will have to incur over the next $3\frac{1}{2}$ months.

In terms of costs:

The increased cost of doing business is certainly no newer to you than it is to Continental and the airline industry. We're looking at a 10%-12% increase in operating costs this year and next without figuring in cost of fuel. Fuel cost is the most serious problem of all. It's real and it is terrifying for us and should be for you, the traveling public.

Let me give you some idea of what fuel costs really mean to the airline industry:

- Fuel costs are already $2 million more a day today than they were last year. At Continental, a 1¢ a gallon increase equates to a $3 million annualized expense.
- An added $1/barrel tax on oil will cost the industry an added $100 million/year.
- And if domestic crude is decontrolled, the Air Transport Association estimates another $500 million in costs for 1 year, $1.6 billion over the next 31 months. If the industry is to absorb this huge increase in cost without a fare increase, it is estimated that we will have to reduce 20% of our capacity, ground 350-450 airplanes, and furlough 45,000-50,000 employees. This drastic action, in turn, would obviously impact resort areas, hotels and other elements of the leisure market.

Setting the big questionmark of fuel costs aside, I think we would be rather optimistic about the growth of air travel in 1976.

[1] Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colo., Sept. 14-19, 1975.

[2] Vice President, Passenger Market Development, Continental Airlines, Los Angeles, California.

- Data Resources, Chase Econometries, the IDC, UCLA and G.E. Mapcast forecast a real GNP growth for 1976 of about 6%.
  - Since there is a very close correlation between air travel and GNP, the airline industry is also looking for a growth of about 6% in 1976 vs 1975.
  - And we are looking for this growth with only modest increase in capacity - about +3% due chiefly to equipment replacements.
- With growth in GNP should come growth in DPI in 1976 and that should be good for leisure travel. People today are changing their lifestyles and vacation travel is growing as a percent of average family expenditure. New liberalized charter regulations may encourage additional leisure travel to vacation destinations, although the outlook is confused at the moment.

With a vital airline industry and resumption of air travel demand, we can look toward an increase of market development activities by the carriers which, as I mentioned, can have a major impact on the growth of resort areas and leisure properties. For example, I think most people would agree that United Airlines has played a major role in the development of Hawaii as a leading vacation destination. Likewise, Captain Eddie Rickenbacker and his Eastern Airlines helped turn Miami Beach from a summer resort into a year-round playground. Continental has developed and promoted winter and summer vacation programs to Colorado, travel to California and Hawaii, and is involved in a major destination building project with the Islands of Micronesia.

We provide films, brochures, displays, advertising and promotion support, including sales calls.

Additionally, several of the carriers have invested in hotel properties at some of their key destinations to help insure adequate and suitable ground accommodations. I refer here to United's Western International Hotels, TWA's association with Hilton International, Pan American's Intercontinental chain and our own Continental hotels in the Pacific.

Beyond the active marketing support of the carriers it is essential that a broad array of specific destination and product information be made available to other channels of distribution for resort areas. Specifically, travel agents in this country are now accounting for close to one out of every two airline revenue dollars. They influence destination, carrier, hotel, length of stay, and a host of other important aspects of vacation planning. At the moment, travel agents have a better working relationship with hotels rather than condominium associations or managers. There is not yet a simple comprehensive information system on non-hotel, leisure properties for travel agents. We all know that people sell what is easiest and I don't think we will see real growth in the condominium rental area until knowledge and communications and trust in product quality are improved in the travel agent community. Continental has worked with the Colorado properties to improve knowledge, understanding, and ease of sale. We gained experience last ski season and we have made further improvements for this year's program. We will continue to do so since we are convinced that condominiums have a place in the marketing mix.

Yet another important factor in the outlook for specific leisure properties and resort development is the image, if you will, of the various destinations. Whether it is cars or condominiums, the American public is influenced by image. Each resort destination has to determine what it wants to stand for in the public's mind. Hopefully, this will represent a unique positioning which is consistent with the target market's expectations and, importantly, consistent with the actual market characteristics which will be experienced by the vacationer. Clearly, the Rocky Mountain area enjoys an excellent image as the outstanding skiing area in the United States. Additionally, the beauty of the Colorado outdoors and the variety of experiences available make it an attractive year-round destination which is yet to be fully developed or exploited. Obviously, a negative product or location image can be a serious problem for a resort destination. You may recall some of the wanton shootings of tourists on one of the Caribbean Islands a few years ago. I can assure you that resort properties and building sites were available at a reduced price for a long time. Likewise, hostility of the local inhabitants toward tourists can spread through press reports and the tourist grapevine. The Bahama Islands

were faced with this problem prior to their independence. The Parisians have it now and it, plus rising ground costs, have hurt demand for vacations in France.

Miami Beach tourist interests are engaged in a major upgrading of this area, especially in hotels, beach, and service, to help continue its growth through the 70's. A destination can become passe if it doesn't maintain its facilities and control its development. Likewise, "people pollution", crowds and noise can be problems.

Conversely, Hawaii's reputation for the "Aloha spirit" plays as much or more important a role as the sun, sand, and surf in Hawaii's continued growth and strength as a leading vacation destination.

Then there is the problem, or opportunity, on how to increase the awareness of a resort or leisure properties' image and characteristics among its target audience. If people don't know you, you don't sell much. Obviously, research plays a major role in market positioning and so does promotion and publicity. I think everyone would agree that President Ford's affinity for this area has had a salutary affect on awareness and consumer impression. Mr. Nixon did the same thing for Key Biscayne.

Since we don't all have the luxury of a President's publicity program, some of us have to increase awareness the hard way. At Continental we have elected to improve consumer awareness of the unique hustle and spirit and pride of the Continental people. About a year and a half ago the Benton and Bowles Advertising Agency came up with a slogan "We Really Move Our Tail For You" which built nicely upon the airline's slogan for seven years--"The Proud Bird With The Golden Tail".

Significant improvements in consumer awareness of Continental and its destinations have been reflected in research surveys and, not so incidently, in our business. I mentioned earlier that the airline industry has declined 0.6% in the first eight months of this year. During this same period, Continental has grown 7.4% vs a year ago in revenue passenger miles, and our market share is the healthiest in recent years.

The last element which is essential to continued orderly growth in resort properties is the time and dedication of concerned individuals such as those attending this symposium. This perhaps is the most critical element, for if we don't take the time to address the problems and develop solutions, to develop directions, strategies and plans, our outlook will be dim indeed.

I would like to close with the following verse taken from a volume titled "Prayers of Life" - on the subject of time:

"Good by, Sir, excuse me, I haven't time.
I'll come back, I can't wait, I haven't time.
I must end this letter, I haven't time.
I would love to help you but I haven't time.
I can't accept, having no time.
I can't think, I can't read, I'm swamped, I haven't time.
I would like to pray, but I haven't time."

I salute you for taking the time to discuss critical problems of environment and growth, and I thank you for your kind attention.

Planning and Legal Considerations Affecting Land Development*

By James D. Mertes**
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Environmental land resource planning and management is a very popular subject with an increasing number of people. The nature of this interest varies depending upon one's station in life and interest in the various aspects of land development and management. Certainly, since the passage of NEPA[1] in 1969, the increased activity in the area of land use planning has had many far reaching implications for persons involved in selling and developing land for urban and non-urban purposes.

Working in tandem with the ecological land resource analysts and planners have been the lawyers. Their mission has been to draft and defend land use guidance systems which serve to implement comprehensive land use plans. A principal objective of this activity has been to guide land use decisions so as to avoid mistakes which in the past have resulted in a considerable loss of environmental resources and aesthetic values, public endangerment from flooding, landslide, or subsidence, and excessive public costs for expensive corrective action.[2] Out of all of this has come a realization on the part of many that reliance on a virtually unconstrained land market is not a firm guarantee that land will be used properly, that maximum development opportunities will be discovered, that the greatest number of land use conflicts resulting in undesirable ecological and social externalities will be avoided, and that highly valued resources will be preserved for future generations to enjoy.[3]

This paper represents the efforts of a planner and lawyer to examine and highlight some current activities in the area of land use planning and management and to discuss how these activities relate to the operation of the land market as it pertains to the various categories of leisure properties. It must be stressed that this paper represents only an overview of a very complex and constantly changing area of public and private policy activity. Because of the likelihood of change, current events are discussed and related insofar as is practicable to the future market for leisure properties development.

The objective of land use planning ultimately is to arrive at some determinations as to how land within a prescribed planning area will eventually be developed. Who decides, and more important, how these determinations are made, stir considerable discussion among citizens, land developers, and public officials. Once the determinations are fairly well locked into place by conventional land use controls, the land market, which some argue does not need the benefit of comprehensive planning, responds accordingly.[4]

This process often works at odds with the market and the goals and aspirations of landowners, particularly when its determinations are not in concert with what the individual views as the highest and best economic use of his land. Work with several time-consuming zoning cases has revealed many obstacles to successful implementation of a comprehensive land use planning program. On the other hand, it has also shown how thorough planning, with environmental management objectives, can serve as a powerful complementary force in the land market to create numerous development opportunities.[5]

Pre-NEPA land use planning, or "old planning," grew out of the fields of engineering and city planning.[6] The master plan as conceived in this context was a rigid physical development plan for the precise layout of a city or region. It contained independent studies of streets, utilities, schools, parks, and the like. It had as an end product colored maps showing various land use designations and locations for specific public improvements. All of this was accomplished through our well known Euclidian zone districts[7] and conventional subdivision regulations.[8] Little if any of this physically oriented planning took into account ecological variables, form indicators, or environmental systems analysis. The concept of highest and best use of land was often equated with economic rent considerations for the most part. Land use ordinances were prohibitive rather than encouraging and directing. Development performance guidelines were hardly discussed. Monotony prevailed over diversity.

The passage of the National Environmental Policy Act of 1969 ushered in the beginning of a new era in comprehensive land resource analysis and planning. Earlier concepts of ecological determinism[9] and quality corridor analysis[10] found application as part of the process of responding to Section 102-C of the Act which requires a comprehensive environmental assessment on all federally financed development

Footnotes are listed at the end of this paper.

projects.

The post-NEPA years also gave use to a rebirth of some earlier ideas of land as a complex ecological resource rather than purely a market commodity.[11] Ecological systems analysis and the multiple overlay mapping inventory systems became very popular.[12] Intense interest focused on resources such as soils, water, and vegetation, on forms, and more important, on processes and performance. Old friends like the Soil Survey were rediscovered. Mapping composites identified areas well-suited for development, as well as areas which were perishable, fragile, or where development would present a potential public harm. Design synthesis allowed identification of specific resource constraints as well as opportunities. Flood plains, geologic hazard areas, prime agricultural lands, scenic areas, aquifer recharge areas, shorelands, wetlands, rookeries, landslide areas, alpine meadows, and mountain watersheds were identified and described. Ecological processes were valued and complex relationships explained. Analysis of soil, slope, geologic, and hydrologic data led to the development of land capability composites. Environmental management policies could be promulgated for each capability of ecological performance unit. A final determination, that of land suitability, explained what portion of an area would ideally accommodate specific types of development with the least local or regional environmental impact.[13]

For each land suitability class, resource standards - the appropriate development performance criteria - could be promulgated. Resource constraints based on these standards were promulgated as regulations restricting certain kinds of land uses and development from high hazard or vulnerable areas. Where developments could meet certain performance criteria, they would be allowed in critical areas such as flood plains.[14] Environmentally based land resource plans often exposed desirable development areas where the economic value of the land could be enhanced considerably without costly modification or installation of rectifying devices such as artificial drainage systems. Thus a landowner could assess his proposed development in terms of its probable impact and match this with the land suitability analysis of his property. Certain modifications could be prescribed to make the development compatible with the land, the amendments often resulting in considerable cost savings to the developer and the community.

In addition to identifying lands suitable for high density development, the process also identified lands which contain unique resources or critical environmental processes. These characteristics suggest special protection in the form of severe limitations on the nature or density of development. Critical areas management, open space acquisition, farm land preservation, flood plain management, coastal zone management, and low density zoning are some of the planners' responses for the management or protection of lands falling into the critical, perishable, vulnerable, or public-harm-resulting-from-disturbance category.[15]

In short, the ecological deterministic approach to comprehensive land resource analysis leads to a land use map which is based on sound scientific data resulting from interdisciplinary study and design synthesis. Land use categories are not arbitrarily determined as was often the case in old physically oriented master plans. Because it is objectively drawn, the plan is legally defensible. It may be region shaping. Also the plan can save public funds and enhance public, as well as private, well-being. Being founded on objective data it is less subject to piecemeal attack and recurring, ad hoc amendment. From all of this comes some interesting and often frustrating readjustment within a local or regional land market. At Lake Tahoe, for example, a comprehensive land resource analysis led eventually to the development of a regional land suitability map.[16] The zoning which followed prescribed land use districts and densities based on the environmentally determined land suitability classification. Some lands were up zoned, many were down zoned. Windfalls were few, wipeouts many. The ultimate objective of the plan is to protect the environmental integrity of the region by respecting its intrinsic character. Hopefully, at least in the eyes of the Tahoe Regional Planning Commission, this will insure that through a process of prudent public and private land management the values of Tahoe which attract people to the area will not become the plague which ultimately destroys it.

The problem is a recurring one that is repeated throughout our entire Consortium region--unique resources that are attractive for development are also highly perishable and vulnerable to irreparable deterioration.[17] The same kinds of planning activities previously described are being undertaken throughout the region at the state, regional, and local level. Critical areas are being designated, more stringent performance standards for development are being promulgated, and more acres are being set aside for public ownership and management.[18] Growth management programs that are based on resource limits and availability of financial resources are finding their way into comprehensive plans and land use management programs.[19] Environmental assessments reveal long range implications flowing from some proposed developments that suggest these developments are not in the public's best interest.

In addition to the emergence of more

comprehensive environmental planning methodologies and impact assessment techniques, the ease of developing remote land areas for leisure purposes has been hampered somewhat by the rising costs of energy. It would seem that the end of the era of cheap electrical energy and fuel for motor vehicle transportation is fast approaching if it has not already arrived. The facts concerning an acute national energy problem are obvious. Very real regional energy shortages exist, and fuel prices are skyrocketing. Certain federal and state environmental policies are adding several layers of additional costs to the price of producing and distributing energy. Should this continue, the desire for second property ownership may remain high, but the feasibility and practicality of it may be more closely scrutinized by a larger number of potential property investors.

Fuel or energy availability, price, and type are factors of major interest to land use planners. The factors weigh heavily in transportation planning, clustering and density decisions, siting of energy production facilities and energy transmission lines. Environmental planning and architecture applied to land development can be utilized to effectively conserve energy thereby reducing unnecessary consumption.[20]

Presently, precise data is lacking on the immediate implications of future energy policies on the sales and development of leisure properties. Some observations on future trends, that seem reasonable, are as follows:

1. The market for large, remote rural tracts will continue to evaporate unless cheaper forms of private conveyance, energy, and on-site electrical energy are developed.

2. Emphasis will be on large cluster developments where advanced architectural technology can be utilized for maximum energy conservation.

3. More emphasis will shift to group conveyance such as air, bus, and rail travel to bring people from urban areas to more remote clusters of leisure developments.

4. In some areas there will be considerable conflict arising out of the need to extract energy reserves. Many would indeed be horrified at a plan to excavate and reshape a sizable portion of scenic Colorado in search of oil shale and other energy sources. Some westerners are taking the same attitude towards their scenic mountain areas as easterners are taking towards their undeveloped coastlines.

What does all of this mean in terms of the future availability and location of land for leisure development throughout the region? The answer is by no means simple. In most of the highly attractive mountain areas, the supply of private land for purchase and development is already very limited. The largest land holder, the federal government, appears to be under heavy pressure from environmentalists and urban recreationists to pursue more protection-oriented policies with respect to land exchanges, special use permits, and recreational facility development.

In the mountain states and elsewhere, there is a growing awareness on the part of a wide range of citizens of the economics as well as environmental problems associated with poorly planned land development.[21] In our State of Texas where interest in land use planning is much less than in other areas, people are beginning to question the wisdom of totally uncontrolled land speculation and development adjacent to public recreational resources and within regional scenic attractions. At Lake Amistad, on the Rio Grande River, for example, the county prevailed upon the Legislature for limited zoning powers to help guide land use along the shore of the lake.[22] It is similar to situations found here in Colorado: the area is attracting large numbers of users and uses that ultimately could lead to a serious despoilation of the water resource and adjacent scenic and cultural resources. The latter, of course, are the principal attractions and sources of recreational enjoyment.

Out of all this has come the development of land use suitability determinations that often mean fewer acres of prime development land or much higher costs and stringent constraints on the development of other lands. The land use management programs emerging are varied, complex, and not susceptible to easy modifications. Thus the legal questions, in terms of the impact on the traditional property rights, the compensation for value diminution, and the notions of public welfare equity, are becoming immensely important issues.

Our observations, drawn from the study areas where this kind of land use planning and management has been underway, are these:

1. Speculative futures with respect to the highest and best economic use concept of land development potential do not always correlate with the appropriate land suitability.[23]

2. Adoption of environmental land use plans and subsequent land use management programs often results in land development density reductions for many parcels of property. This was the case recently at Lake Tahoe. The Tahoe Regional Planning Agency on August 29, 1975, initiated implementation of land use regulations of its much discussed regional environmental land resource plan. The plan proposes to limit development within the California portion of the environmentally sensitive basin. Adoption of the plan means that many properties will be downzoned to densities suggested by the land suitability analysis. This is highly endorsed by environmentalists. Property owners on the other hand are deeply concerned over the monetary diminution that would likely result from the downzoning. A solution appears to be precise documentation of the exact nature of the wipeout in terms of individual landowners as well as the regional economic base. Clearly such action creates land locational advantage and economic enhancement to those property owners whose land is allocated higher development densities.[24]

   The affected land owners, needless to say, will go to court claiming the planning and land use regulations, which are aimed at protecting a fragile public trust resource and prevent the occurrence of hazardous conditions, create a taking of their property for which just compensation should be paid. Paid by whom? Where will this extra money come from? Interesting, but not easily answered questions.

3. Density reductions in some areas create for property owners whose land happens to be in the right suitability group a handsome windfall in appreciable value of which they were unaware. The land supply available for certain kinds of resort developments has been artifically reduced, and thus its value driven much higher in a very manipulated land market. Should these fortunate recipients of this new wealth have their increased benefit recaptured to help compensate their unfortunate neighbors who are blessed with ecologically sensitive land that is very valuable to the regional ecosystem and the production stream of environmental and aesthetic values, but now of little interest to the local realtor who once had plans to locate a mammoth resort condominium there?

The focal point of this issue centers around a seemingly insatiable demand to enjoy the benefits of recreation in scenic areas while still maintaining the quality of the area so that it continues to be attractive and rewarding. This situation is best stated by Mr. Justice Sullivan of the California Supreme Court in a case dealing with the administration of regional planning and land use management within the area covered by the Tahoe Regional Planning Compact. Mr. Justice Sullivan observed:

> . . . There is good reason to fear that the region's natural wealth contains the virus of its ultimate impoverishment. A staggering increase in population, a greater mobility of people, an affluent society and an incessant urge to invest, to develop, to acquire and merely to spend. . . . all have combined to impose a severe threat to the Tahoe region. . . .Today, and for the foreseeable future, the ecology of Lake Tahoe stands in grave danger before a mounting wave of population and development.[25]

Many similar Tahoes are within this region. The answer is obviously not one or the other, but a balance of both development and attractive environment. This balance cannot come about within the market alone. Certain considerations and constraints which extend beyond the reach or influence of any one decisionmaker can only be brought to bear by a representative body having a broad region-wide scope of interests and authorities. The market balance will be changed with resultant locational advantages enhanced as well as diminished. Hopefully more development opportunities with greater options for diversity and market innovativeness will emerge. Properly conducted comprehensive environmental planning should generate these kinds of results.

The land use management strategies developed in the past few years to implement land use plans and protect environmental resources are complex and far reaching in terms of their legal implications. Many reach to the core of our fundamental institution of private property and the proper role of government as a sovereign or a trustee of certain common property resources. Others place government in the role of arbiter between the public interest and the private interest in land as well as the determiner of the quality of life resulting from land use. A survey of some of these land use guidance systems will

illustrate methods used to implement environmental planning and the legal issues inherent in them.

Historically land use planning has not been conducted on the basis of ecological land capability. Rather it is typically negative in nature, limiting particular uses to particular areas. Often these determinations turn principally on economic and practical, rather than on environmentally-related considerations. As the nature of land use planning has changed from merely a locational issue to a determination of what land is best suited for a particular activity, several problems have emerged. A major problem has been obtaining the requisite land resource inventory analysis and design synthesis which is essential to making suitability and capability determinations. That problem is basically a planning and management problem. However, another problem that is legal in nature is how to make the land use decision coincide with the ecological planning and management decision regarding the appropriate use of the land. Today many federal and state laws are forcing the decision-maker to make land use determinations in light of not only the economical and practical factors, but also in light of the environmental and ecological considerations about the land. In some instances such as the Vermont legislation,[26] the legal requirements are very direct; in others, particularly in the federal areas,[27] the requirements may be indirect and, sometimes as under the federal Clean Air Act,[28] not even principally realted to the land use issue.

Examples of both the state and federal legislation, as well as some new local land use ordinances, will be discussed. These examples were not selected as being inclusive of all the possible devices with respect to land use regulation or legislation. They have been selected because they are representative of different approaches to guiding land use currently being taken by state, federal, and local governments. Also the examples illustrate a variety of procedures available to those responsible for implementing environmentally determined land use plans and policies.

The principal enactments at the Federal level that affect land use decisions are the Federal Water Pollution Control Act Amendments of 1972,[29] the Clean Air Act Amendments of 1970,[30] the Noise Pollution Control Act of 1972,[31] the Coastal Zone Management Act of 1972,[32] and the National Environmental Policy Act of 1969 (NEPA).[33] NEPA will be discussed first because it is probably the most significant legislative enactment on environmental problems in recent years. Basically the Act is an environmental policy statement by Congress and reflects growing concern at the congressional level over the environmental costs that occur in federal projects. NEPA is also a good example of a law that affects land use planning indirectly. The Act itself says nothing about land use decisions or where particular activities should occur. But the Act is designed to bring environmental considerations into the decisionmaking process, and it is at that juncture that it affects land use decisions. Here also the Act evidences a growing awareness of the significance of land capability as a determinant of land use. NEPA operates by requiring that a federal agency prepare what has become known as the Environmental Impact Statement (EIS) on all federal or federally assisted projects significantly affecting the quality of the human environment.[34] The Act sets forth what the EIS must contain. The entire project and its environmental consequences must be described in the EIS. Then it must discuss alternatives to the proposed action, the relationship between the short-term uses and long-term productivity, and any identifiable irreversible and irretrievable uses of natural resources that would result if the action is carried out. The Act further requires that the EIS be made available for public criticism and comment and that it be included among all the project's materials through each of the agency's internal stages for approval. In this manner the EIS becomes one of several factors that the decisionmaker has before him at the time of making the decision to proceed with the project. The EIS must also be circulated to appropriate federal agencies that would be concerned with the project for interagency comments on the project.

Obviously NEPA does not apply in every local zoning situation. In fact the Act only requires the EIS be prepared by a federal agency when it is undertaking a major federal action.[35] Also the courts have been reluctant to get involved in strictly local matters and try not to sit as a super zoning board. Even when a court has not required an EIS, though, the local citizens may be effective in delaying construction or requiring modifications to a project by requiring a public hearing and a report by the agency on why the EIS is not required. That was the situation in Hanley v. Kleindienst[36] where local citizens objected to the location of a federal courthouse and jail in downtown Manhattan in New York City. Similar problems can arise under NEPA concerning the location of offbase housing for military personnel[37] and of other federal facilities. Although a court may deny a dissatisfied local resident any rights under NEPA when the location of a federal facility is involved, the potential for its application exists.

The principal and most successful use of

NEPA has been in requiring an EIS in projects in which the federal government is directly involved. In many cases against different departments of the federal government the agency has been enjoined from commencement or completion of a project until an adequate EIS has been prepared. These cases affect planned community development directly. The case examples include situations in which federal government has been leasing federal land for particular purposes without preparing an EIS prior to leasing. In those situations the courts have almost uniformly required that the agency prepare an EIS.[38] These cases include everything from leasing lands for timbering and mining to the leases of the lands on the outer continental shelf.[39]

Developers must be aware of NEPA and the EIS requirements in several instances. Frequently the land being developed, e.g., the Rocky Mountain area, is leased, purchased, or under special use permit from the federal government. In those instances the agency involved would probably be required to prepare an EIS. But even if the land to be developed is private land, NEPA compliance may be required if funds for purchasing the land or underwriting part or all of the development are coming from a federal source. Federal funding often is required on large-scale developments because of the large capital outlay for the land. If funds are sought from HUD under the Urban Growth and New Community Development Act[40] or other federal legislation providing loans to private individuals, the project may be delayed until an impact statement is prepared. Thus, in Sierra Club v. Lynn[41] an EIS was required for a planned unit development outside San Antonio, Texas that was going to be situated adjacent to an aquafier recharge area. In another case a private developer was enjoined from clearing land that he was purchasing for development until the federal agency that was making the loan had prepared an EIS.[42] Obviously this would also apply to any areas of federal lands that were being sold or exchanged for private development in the Colorado or region of the Southwest.

NEPA is significant not because it has necessarily deterred or stopped development. In most cases the particular project has been continued and carried out, but with fuller knowledge of the host of environmental factors associated with the development. This in turn permits action to avoid, or at least minimize, environmental harm. By its thoroughness the EIS brings to the decisionmaker's attention the full environmental ramifications of the particular activity. Thus, the suitability of the land as well as the permanent harm to natural resources will be pinpointed in the statement. Although the Act does not give any priority to the environmental factors in the decisionmaking process, it clearly requires that the agency consider and balance these factors with others in making the decision to proceed.[43]

From the developer's perspective, if the federal government is involved in the particular project, it clearly seems advisable to consider whether an environmental assessment should be prepared in advance for use by the agency. By doing this early in the planning process the parties can identify the environmental harm and possibly include action that will avoid those consequences once the project is undertaken.

The next federal legislation to consider is the Federal Clean Air Act.[44] Under that Act the state prepares a plan to implement the national ambient air quality standards and the stationary sources standards. The air quality standards are promulgated by the Environmental Protection Agency, but enforced through the state. The Act would affect developers of second home or resort complexes principally through the stationary source or indirect source regulations. If the particular development will also include a large industrial complex or other new source of air pollution, the Act will require that the current air quality standards be met. If they cannot be satisfied in the region, the activity cannot be located at the particular place. The other principal problem with developing a second home or resort complex would be the indirect source regulations.[45] These apply to sources which by their nature will create additional air pollution problems through traffic or concentration of pollutants. They generally apply to things such as a regional shopping center, a large recreational arena, a traffic artery, or a large housing complex. Each of these activities provide parking area for many vehicles or attract people and cars. The indirect source regulations require that the developer establish for the state agency or EPA that the activity will satisfy the air quality standards prior to construction. Although the Clean Air Act Amendments obviously were not directly related or addressed to land use problems, they clearly have an indirect affect because of the air pollution problem the activity may create.

Another source of regulation that is not so indirect is the Federal Water Quality Amendments of 1972.[46] Under those Amendments the national goal is the elimination of discharge of pollutants into navigatible waters by 1985.[47] The principal section of the Act related to new community or second home developers would be §208 which deals with area-wide waste treatment management plans. Under the Act the plans are to be prepared by the

state to determine areas where the water quality control problems are "substantial." The plans will determine the construction priority, size, and location of waste treatment plants that will be built with EPA funds. The section expressly mentions "land use requirements"[48] to control nonpoint sources of pollution including agricultural and construction activity related sources. Determining the placement of waste treatment plants obviously could affect development of new communities or location of industry. In addition under the Amendments all point sources of pollution into navigatible waters must have a discharge permit.[49] One result might be that more sprawl is encouraged because a subdivision or housing district may move further out of an urban center to a less polluted place where the sewer treatment plant would be authorized rather than building the development closer to the heavily polluted urban area.

Another example of federal legislation indirectly impacting land use is the Noise Pollution Control Act of 1972.[50] The Act basically is designed to control the quantity of noise emitted by construction, transportation, or other heavy duty equipment. But it has an indirect effect on residential development. For example, the Department of Housing and Urban Development (HUD) has determined that residential areas should be free from excessive noise. Regulations promulgated by HUD do not allow federal assistance to residences in areas subject to high noise exposure.[51] The principal concern is that residential developments might be located too near highways or airports. Obviously depending on the distances of the second home development from an urban area, location of a highway or airport could be an important consideration. Noise pollution also has been a consideration in all HUD programs on which an EIS is required by NEPA.

The last federal legislative example is one that relates more directly to land management decisions. It is the Coastal Zone Management Act of 1972.[52] A primary purpose of that Act is the preservation, protection, and enhancement of the nation's coastal areas. The Act undertakes this by encouraging states to create a coastal zone management plan that would identify the coastal areas needing restoration or preservation. The Act also encourages full consideration of ecological, cultural, historical, and aesthetic values in the development of coastal regions. By requiring a comprehensive plan as a prerequisite for developing coastal regions, the Act strives to have the land use decision based on a capability study of the coastal zone.

Of course, of some interest in the future will be the national land use policy. In the past two legislative sessions Congress has proposed a national land use act that to date has not become law. But the close margins and the strong Congressional support for the legislation clearly indicates that it may become effective. The general federal plan is similar to the Coastal Zone Management law in that it encourages states to adopt statewide land use plans. The purpose is to provide federal aid for research and inventory of state land and to have a state agency created to implement statewide land use planning.[53] Obviously, if adopted, such legislation would be significant for future development.

In recent years several states have been reexamining their land use policy and practice. Frequently, awareness of the severity of the impact of certain land uses and a recognition of land as a scarce resource has been the primary motivating force. Hawaii was the first state to embrace a planning program on a statewide basis.[54] Today, Maine, Vermont, Colorado, California, are but four from an increasing number of states that are considering or using comprehensive, statewide, land use planning programs. The particular examples discussed are selected because they are thorough and comprehensive; also, they are receiving widespread attention as models for other states. Hence, they may illustrate the future of statewide planning.

The Vermont program is a good example of legislation trying to get land use decisions based on ecologically determined land suitability classifications. This is done by requiring all development be done according to a statewide land use plan. Vermont has adopted a permit system. Under the Vermont legislation the sale or construction of a subdivision or other development without a permit is prohibited.[55] The development the Act is addressed to includes building on tracts of land involving more than 10 acres, "construction of improvements for commercial or industrial purposes on more than one acre of land within a municipality that doesn't have permanent zoning," and "the construction of housing projects such as cooperatives, condominiums, or dwellings" and, interestingly, construction for commercial industrial, or residential uses above the elevation of 2500 feet.[56] Under the Vermont legislation a state board is created to develop a land capability plan for the entire state. Once that has been approved by the governor and legislature, all development must be approved by the state board and be consistent with the plan. The Act sets forth the particular requirements for procedure, public hearings, and notice with respect to granting of permits. Permits under the plan can be conditional.

The findings the Board must make before

granting a permit show the legislative concern for environmental protection and use of land capability studies. The Board must find that the subdivision or development "will not result in undue water or air pollution," has sufficient water for the future, or will not cause an unreasonable burden on existing water supply.[57] Moreover, the Board must find that the subdivision or development will not 1) cause soil erosion or reduce the capacity of the land to hold water, 2) cause unreasonable highway congestion or unsafe highway conditions, 3) place unreasonable burden on educational, municipal, or governmental services, and 4) have an adverse effect on the "scenic or natural beauty of the area as aesthetic and historic sites of rare or irreplacable areas."[58] Obviously in granting the permit the Board is to consider principally the environmental effects of the activity.

Since the Vermont legislation was adopted, the State Planning Office has adopted a land capability study.[59] The study details not only the background of existing land uses, but goes into great detail about matters relevant to environmental or critical areas management. The study includes detailed examples of the soils, flood hazards, sewage disposal, and water supply problems. It also discusses the problems of demands on land for agricultural, forestry, recreational, and urban purposes. The critical area management examines natural areas, wildlife habitats, flora regions, historic resources, outdoor recreation, and landscape aesthetics. The study is thorough and a good example of an effort by the state to identify regions and determine appropriate areas for specific type development. In addition, the complete study is noteworthy because of its rather positive note of trying to ascertain where development is appropriate.

Vermont also enacted legislation to regulate land speculation in the state by the Land Gains Tax.[60] That tax came under question in Andrews v. Lathrop.[61] The tax was challenged on the constitutional grounds of denial of equal protection because of the basis that it operated. Under the Act land that was sold quickly at a high profit in excess of 100% would be taxed at a graduated rate of up to 60% over a 6 year period. Land that was retained for at least 6 years was not subject to the tax. The longer the land was held the lower the tax. The Vermont Supreme Court upheld the tax against constitutional challenges because it believed the tax was reasonably related to regulating development by controlling speculation on land. The Court held that trying to limit sales of land and to reduce a person's property tax by using the money generated by the land gains tax to cover the reduced revenues of the state were valid legislative objectives and were reasonably related to one another. A different tax approach in New Hampshire, the Home Owner's Exemption Law, was declared unconstitutional under the New Hampshire Constitution.[62]

Another environmental legislative device at the state level is the Maine Site Location of Development Law.[63] Under the law any person who proposes to develop land in any manner that might substantially affect the local environment must first obtain a permit from the State Environmental Improvement Commission.[64] The legislature specifically designated certain types of projects that would require a license. They included developments (1) that are in excess of 20 acres, (2) that contemplate drilling, and (3) that use natural resources within the state.[65] Before obtaining a license from the State Commission, the person proposing the development must show that his plan would protect the public health, safety, and general welfare--in particular that it would avoid environmental harm.[66]

In Re Spring Valley Development[67] raised the issue for the Supreme Court of Maine of the constitutionality of the statute; the court upheld its validity.[68] It first determined that the legislature's purpose was "to insure that commercial and industrial developments, which because of their nature or their size, will impose unusually heavy demands upon the natural environment, shall not be located in areas where the environment does not have the capacity to withstand the impact of the development."[69] In Spring Valley the particular problem was that the person who proposed to sell the land was not going to develop it himself; he had subdivided the land and proposed to sell the subdivisions to developers. His argument was that the state law only applied to the person who would actually be doing the development of the property.[70] The court rejected this argument. It pointed out that residual developments were within the law; in fact, it held that the statutory language "commercial" included subdivision.[71] The court then proceeded through a lengthy opinion to determine the legislative intent and the constitutionality of the statute. The court expressly held that a "limitation of use of property for the purpose of preserving from unreasonable destruction the quality of air, soil and water for the protection of the public health and welfare"[72] was a valid exercise of the police power of the state.

The Maine Site Location of Development statute illustrates another approach to statewide land use planning that focuses on particular types of development and their impact. The Maine Land Use Regulation Commission has produced interim land use standards and

boundaries.[73] It also has published two helpful handbooks that discuss and clearly illustrate environmental harm that can ensue from development. They also show the interrelationship between the planner's ecological planning determinations and the ultimate planning decision. The booklets are "Building in the Wildlandsof Maine"[74] and "Subdividing in the Wildlands of Maine;"[75] both were written and illustrated by a landscape architect. Interestingly, the considerations that led to adoption of the Maine System included possible new oil refineries and a deep-sea port for supertankers.[76] Similar considerations, such as the development of oil shale reserves, may induce other states in the West to follow Maine's lead.

Another means to bring the environmental considerations into the land use decisionmaking process is typified by the California Environmental Quality Act.[77] That Act is basically a verbatim copy of the federal NEPA except that it applies to all state agencies. The principal purpose of the Act is to get the environmental factors into the decisionmaking process at an earlier time and to have these considered by the decisionmaker. The Act obviously would necessitate more environmental studies and analysis by the state agency prior to making its decision. The California Act has been held to apply to private projects that are being licensed or approved by state or local governments in Friends of Mammoth v. Bd. of Sup'rs. of Mono County.[78]

In addition to these state programs regulating the use of land are various local efforts by municipalities. These may come in the form of agricultural, open space preservation, natural area management, or critical areas zoning. But sometimes their designation is more suspect and indicates their effect on land development, e.g., minimum acreage zoning. Steel Hill Development, Inc. v. Town of Sanborton[79] vividly presents the conflicting values at issue in situations involving zoning or rezoning for larger minimum acreage requirements. On its face the case seems relatively simple. The developer had purchased over 500 acres of land, which he sought to develop as a seasonal or second home development for persons in the Boston area 100 miles from Sanborton. The town had a permanent population of 1000 which would be doubled by the proposed development. Negotiations to permit cluster zoning failed, and the townspeople voiced serious opposition to any development. The planning board finally rezoned an area that encompassed 30 percent of the plaintiff's land from a requirement of 35,000 square feet for a single family home to a 100,000 square foot requirement. The remaining 70 percent of plaintiff's land was rezoned from three to six acres for a single family home.[80]

The federal circuit court of appeals upheld the zoning in Sanborton,[81] but not without serious reservations. The court feared the exclusionary effects of minimum acreage zoning. Although the court clearly believed that municipalities may zone in the public interest for environmental considerations, the environmental considerations must be real, not speculative. They must be based on sound scientific studies and analysis of the land and its capabilities, or run the risk of being arbitrary.

Sanborton raises another reason for legislatures or planning boards to obtain thorough land environmental capability studies: the regulation or use restriction can objectively be defended if challenged in court. At that juncture the planner's and lawyer's work mesh totally.

The taking issue is a very complex problem, especially in land use planning. Two cases will be used to illustrate not only the taking issue, but also land resource planning through critical areas management and a regional interstate compact.

The latter situation was presented in Brown v. Tahoe Regional Planning Agency.[82] The case involved a class action brought by persons who own land within the Lake Tahoe region as it is defined in the Tahoe Regional Planning Compact. The compact was entered into by California and Nevada as a means to coordinate planning through a regional agency that would be comprised of persons from both states. The agency adopted a land use ordinance that would apply to all lands in the Lake Tahoe basin, whether in California or Nevada. The plaintiffs alleged that they own land in the particular area and that the ordinance is so restrictive that it deprives them of any private beneficial use of the land. The taking issue, as alleged by the plaintiffs, is that the ordinance in effect takes their land for public purposes such as conservation, recreation, parks, or forestry purposes without any compensation to them. The court in Brown, held "that public welfare and necessity may reasonably require exceptionally restrictive land use classification for the protection of the public interest in the Lake Tahoe basin, but that such valid regulations may nevertheless constitute a taking of private property for public use entitling the owner to just compensation."[83] In addition, the court held that the plaintiff did not have to exhaust his administrative remedies under the ordinance because his challenge was to the constitutionality of the ordinance. The court proceeded to deny the motion to dismiss the complaint.

Another case involving the taking issue dealt with state legislation and a local ordinance for critical areas management. Wisconsin has adopted a Navigable Water Protection Statue[84] designed to preserve shorelands and wetlands for conservation purposes. Under the statute counties may zone to restrict uses on wetlands within a certain distance from navigable waters of the state.[85] Marinette County in Wisconsin adopted a shoreline zoning ordinance that restricted filling or otherwise modifying wetlands within its district. This shoreland protection ordinance came under challenge in Just v. Marinette County.[86] In that case the plaintiffs had attempted to fill wetlands which they owned that were within the restricted area of 1500 feet from the water. The county enforced the ordinance against them on the grounds that they had not obtained necessary permits to fill the land. The Justs contended that the county had taken their land without compensation. The Wisconsin Supreme Court upheld the ordinance.[87] In its opinion the court held that the state could take protective measures to conserve shoreland and protect unpolluted waters that are clean in their natural state. The court stated that the County was not attempting to acquire property for public uses but rather sought to prevent harm to the public right to the land in its natural state. The court held that the county could restrict the Justs to the natural uses on the unimproved land.

Although the Just court held that the land was not taken requiring compensation, certainly its speculative value as a resort development was diminished. In one sense the decision reflects, and preserves, the value of the land in its natural state, as a wetlands. Stated otherwise, the land's capability is as a component of an ecologically complex, lake system and not as development property. This type of zoning for conservation purposes or by designating particular areas as requiring special management has been highly controversial.[88] But in many states the critical areas are coming under great pressure for development. Areas such as wetlands, flood plains, and scenic mountain areas may be the only available land for development of scenic, resort complexes or second homes. In those instances these areas may have high demand for that type development and from a locational viewpoint are the only areas available close to the seasonal activities. But the development obviously can impair or destroy those intrinsic features highly valued by the public. And as other land for development comes even more scarce within some states, not only areas of critical environmental concern, but also prime agriculture lands, and land for forestry or other purposes will be threatened by development. Probably in each instance where the state takes action to protect or conserve land in the natural state the issue of whether the individual's property has been taken for public use without compensation will be raised and have to be resolved in the courts. One answer to the taking issue is that the state directly purchase the land or the development rights on lands. Obviously a greater financial commitment by states is necessary to purchase outright the land for open space or conservation purposes. However, the various proposals for compensation in particular situations, including transfer development rights, should be considered because they can alleviate the problem greatly.

In retrospect it might seem that the environment itself imposes the greatest constraint on development of land. Future planning will have to be environmentally oriented. Environmental land capability studies provide an affirmative way to protect the environment and to promote development. It is not negative or no growth planning. In fact, in many instances it has been demonstrated that land use planning is better for both the developer and the public. On the one hand, it achieves greater protection of the environment, minimizes environmental harm, and significantly reduces both public and private costs. On the other hand, it designates areas that are safe and suited to the particular development being undertaken. This serves to protect and enhance property values, thereby making it desirable to both own and sell property. While certain localized scarcities may occur as a result of comprehensive land use planning, the land market is not destroyed entirely. In that context both the developer and the public benefit. The savings resulting from detailed studies and analysis of land capability before undertaking any development are indeed very real.

Today a definite movement towards more comprehensive environmental land resource planning and management is underway. Citizens are becoming more aware of land use abuses as well as more knowledgable about ecology and environmental land use interdependencies. As voters and participants in society, citizens are more willing to press for higher levels of environmental quality, even if it means a higher cost of living and more restrictions of their individual activities.

Clearly the mood of citizens in many areas of the country, including this region, is undergoing a drastic change with respect to the traditional attitude towards land as property. A land resource ethic is definitely emerging. Citizens who do not own land or who do not have a direct economic interest in the products of the land are exerting, and no doubt will continue to exert, a greater force in issues of preservation, conservation, and management of

public as well as private land. In Just, supra, Chief Justice Hallows spoke of the court as a mirror of contemporary social values. Thus when he determined the action did not constitute a taking of private property, but simply a public constraint on the use of property to prevent a public harm, he spoke of a large class of people who may never come in direct physical contact with the resource.

When land is viewed as a nonrenewable resource, legislative restraints may be sought to protect against harm to the public's interest in it. The future also will bring equally complex problems concerning by whom and how the public's interest in land will be protected. A significant increase in the degree of public involvement in land use planning and management will occur. This involvement may take the form of greater demands for public land acquisitions for open space and environmental conservation, for more stringent environmental performance standards for many kinds of land uses, and for more designations of critical environmental areas where land conversion and development will be strictly governed. Likewise, an increase in statewide and regional land use planning and management will result.

A final note. In April of this year the American Law Institute released its Proposed Official Draft of A Model Land Development Code.[89] This is the result of fifteen years of careful study of American land use planning and regulatory experiences that many believe have created more land use problems than prevented. The model code presents several novel concepts, the most notable being a move away from the Euclidian concept of uniform zone districts. The Code's approach emphasizes environmental performance and a multi-level approach to guiding land use decisions. It includes features such as requiring a permit for certain kinds of developments and provisions for public land reservation, land banking, and state regulation of large scale land developments having regional impacts. A variation of the code has already been adopted in Florida and is working with a fair degree of success.[90] Many believe those states interested in taking a more active role in land use planning and management will consider and probably adopt most, if not all, of the Code as a substitute for the Standard Planning and Zoning Enabling Acts of the 1920's.

The handwriting is on the wall. Development of leisure properties in fragile environmental areas will no doubt continue; however, the constraints will be more stringent, the supply of developable land perhaps less, and the costs of development higher.

NOTES

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17. Dennis L. Lynch and Standish R. Broome, Mountain Land Planning (Fort Collins: College of Forestry and Natural Resources, Colorado State University, September 1973).

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20. "The Costs of Sprawl: Environmental and Economic Costs of Alternative Residential Patterns at the Urban Fringe," Washington, Office of Policy Research, Council on Environmental Quality, Department of Housing and Urban Development, Office of Planning and Management, Environmental Protection Agency and Real Estate Research Corporation, April 1974.

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23. Fred Bosselman, David Callies, and John Banta, The Taking Issue (Washington, D.C.: Council on Environmental Quality, 1973).

24. Land Use Planning Reports, Washington, D. C., Plus Publications Inc., vol. 3, no. 3, August 18, 1975, pp. 7-8.

25. People ex rel. Younger v. County of El Dorado, 487 P.2d 1193 (Cal. 1971).

26. Vermont Land Use Law, 10 V.S.A. §§6001 et seq. (1970) and Vermont Land Capability and Development Plan Law, H. 326, Effective July 1, 1973.

27. National Environmental Policy Act of 1969, 42 U.S.C. §§4321 et seq. (1970).

28. E.g., Federal Clean Air Act, 42 U.S.C. §§1857 et seq. (1970). However, transportation control plans under the Act do affect land use, but they are not discussed in this paper because they primarily are used in urban areas, not second home or resort development complexes. See, South Terminal Corp. v. E.P.A., 504 F.2d 646 (1st Cir. 1974) and Pennsylvania v. E.P.A., 500 F.2d 246 (3d Cir. 1974).

29. 33 U.S.C. §§1251 et seq. (Supp. 1975).

30. 42 U.S.C. §§1857 et seq. (1970).

31. 42 U.S.C. §§4901 et seq. (1972).

32. 16 U.S.C. §§1415 et seq. (1972).

33. 42 U.S.C. §§4321 et seq. (1970).

34. 42 id. §4332 (2)(c) (Supp. 1973).

35. Id.

36. 484 F.2d 448 (2d Cir. 1973).

37. Town of Groton v. Laird, 353 F.Supp. 344 (D. Conn. 1972).

38. E.g., Sierra Club v. Morton, 7 BNA Env. Rpt. 1977 (D.C. Cir. June 16, 1975).

39. Wilderness Society v. Morton, 479 F.2d 842 (D.C. Cir. 1973)(Mineral Leasing Act); Natural Resources Defense Council v. Morton, 458 F.2d 827 (D.C. Cir. 1972)(Outer Continental Shelf leases); and Minnesota Public Interest Research Group, 498 F.2d 1314 (8th Cir. 1974) (timbering).

40. 42 U.S.C. §§4501 et seq. (1970).

41. 502 F.2d 43 (5th Cir. 1974).

42. Silva v. Romney, 473 F.2d 287, aff'd sub nom., Silva v. Lynn, 482 F.2d 1282 (1st Cir. 1973).

43. E.g., Calvert Cliff Coord. Com. v. A.E.C., 449 F.2d 1109 (D.C. Cir. 1971).

44. 42 U.S.C. §§1857 et seq. (1970).

45. 39 Fed. Reg. 37922, Oct. 24, 1974.

46. 33 U.S.C. §§1251 et seq. (Supp. 1975).

47. Id. §1251.

48. Id. §1288(b)(2)(F)(G) and (H).

49. Id. §1311.

50. 42 U.S.C. §§4901 et seq. (1972).

51. For discussion of HUD regulations see, Federal Environmental Law (West: St. Paul, Minn.) Ed. by E.C. Doglin and T.G.P. Guilbert, p. 1202-09.

52. 16 U.S.C. §§1415 et seq. (1972).

53. For a general discussion of national land use planning proposals and bills, see, Federal Environmental Law, note 51 supra at 1415-65. See also S. 268, 93d Cong., 1st Sess. (1973).

54. Hawaii uses a state board to do zoning for the entire state. Some aspects of the program are indigenous to that state. For a thorough discussion of the program and studies, see, The Quiet Revolution in Land Use Control (CEQ Wash., D.C. 1971).

55. 10 Vt.S.Ann. §6081.

56. 10 id. §6001.

57. 10 id. §6086.

58. Id.

59. Vermont Land Capability (Vt. State Planning Office: Montpelier 1974).

60. 32 Vt.S.Ann. Chap. 236.

61. 315 A.2d 860 (Vt. 1974).

62. Felder v. City of Portsmouth, 324 A.2d 708 (N.H. 1974).

63. Me. Rev. Stat. Ann. tit. 38, §481 (Supp. 1973).

64. Id. at §482.

65. Id.

66. Id. at §484.

67. 300 A.2d 736 (Me. 1973).

68. Id.

69. Id. at 741-42.

70. Id. at 745.

71. Id. at 742.

72. Id. at 748.

73. "Standards for Interim Land Use District Boundaries and Permitted Uses," (Me. Land Use Regulation Commission: Augusta, Me. Rev. 1973).

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75. Id.

76. See, The Quiet Revolution in Land Use Control note 54 supra at 187.

77. Cal. Pub. Res. Code §21100 (Supp. 1974).

78. 502 P.2d 1049 (Cal. 1972).

79. 469 F.2d 956 (1st Cir. 1972). For more recent litigation in the same case, see Steel Hill Dev., Inc. v. Town of Sanborton, 27 Z.D. 1 (unreported decision by the D.C.N.H., Dec. 30, 1974), where the court refused to review the validity of the same ordinance that was involved in the earlier case.

80. 469 id. at 959.

81. 469 id. 956 et seq. For a fuller discussion of this case and the exclusionary ramifications of minimum acreage zoning, see, Skillern, Environmental Legislation - An Alternative to Minimum Acreage Zoning, 6 Tex. Tech. L. Rev. 1 (1974). The cases collected there reflect the mixed judicial attitude toward large lot zoning.

Another recent decision by the New Jersey Supreme Court warrants attention because it overruled local zoning ordinances on exclusionary grounds. But also the court imposed affirmative duties on the community to plan low-income housing and to consider regional, as well as local growth. So. Burlington Cty. N.A.A.C.P. v. TP. of Mt. Laurel, 67 N.J. 151, 336 A.2d 713 (1975).

Also a significant case holding that a community can zone to regulate growth and preserve its rural character is Construction Industry Assoc. v. City of Petaluma, 8 BNA Env. Rptr. 1001 (9th Cir. Aug. 13, 1975). The case involves a controlled or "no growth" ordinance that was overturned by the trial court on grounds that it infringed the individual's fundamental right to travel. The appeals court disagreed and upheld the ordinance against all constitutional challenges. Id.

These recent developments are important because they deal with recent local responses to premature and sometimes unwanted growth.

82. 385 F.Supp. 1128 (D. Nev. 1973).

83. Id. at 1132.

84. Wis. Stat. Ann. §144.26 (Supp. 1974). See also Del Code Ann. tit. 58 (1971) for a similar coastal protection statute.

85. Wis. Stat. Ann. §144.26 (Supp. 1974).

86. 56 Wis. 2d 7, 201 N.W.2d 761 (1972).

87. Id.

88. See, e.g., Bartlett v. Zoning Comm'n., 161 Conn. 24, 282 A.2d 907 (1971); State v. Johnson, 265 A.2d 711 (Me. 1970); Comm'r. of Natural Resources v. S. Volpe & Co., 349 Mass 104, 206 N.E.2d 666 (1965); cf. Goldblatt v. Town of Hempstead, 369 U.S. 590 (1962).

89. ALI Model Land Development Code, (Proposed Official Draft) (American Law Institute; Philadelphia, Pa. Apr. 1975).

90. For a thorough discussion of Florida land use see, Luther J. Carter, The Florida Experience: Land and Water Policy in a Growth State (John Hopkins Press: Baltimore, Md. 1974).

Who Will Be the Future Buyers and Principal Users of Each Category of Development?[1]

William Sims[2]

One thing we've all found out this morning is that we have done very little research on who is buying now, who's selling, and what we expect to happen in the future. So what I would like to do is tell you, from a practical standpoint, about the people who actually have to sell all this stuff that's built to the people who come here to the mountains.

Usually they don't know why they're here, but they're ready to buy something. So, let's look at a profile of who buys, who sells, and who uses. Probably they're going to be the same people in the future that we have right now.

The buyer we have today is a man who comes into the mountains and wants to buy near Dillon, Colorado, preferably on the lake, 80 acres, with a house on it and a barn and a stream and a good view. He would like to pay about $600 an acre. At that price, the closest I can get him to Dillon Lake would be somewhere in western Kansas. But this is what people come into the mountains and ask for. They want cheap land with a big house on it and a view and all of these things. Those things are long gone, and you and I both know they will never be recovered again. When we tell prospective buyers that the closest lot you can get them is $3,000 an acre they just are completely flabbergasted--they've never heard of such outrageous prices. So, you spend about six hours talking with them, in maybe two different visits, and end up selling them a quarter-acre site for $11,000 and they're happy.

A man who buys a house usually comes in first to rent one. When you tell him you haven't had a house to rent for almost two years, he starts laughing. When you show him houses at $50,000 to $60,000 that he can buy in Denver for $35,000, he understands the problem. So you usually end up with him in a condominium.

Whether condominiums will be bought in total or by some type of time sharing or some other method we don't know yet. All we know is that the person that normally buys real estate buys because he's emotionally involved. It's an impulse item, an item he buys because he likes it. You can talk to him all day about how good the price is, how great the condominium is, but he's going to buy what he likes if he can afford it. He is going to buy something he absolutely doesn't need. There isn't a single person in the audience who needs a condominium in Vail, Colorado today unless he's going to live here permanently.

Another problem is trying to get a man and his wife to agree on what they want. So you analyze them and figure out which is the strongest, who's going to make the decision, and you ignore the other one. So you end up selling the wife.

The payment, if he finances it, is going to be higher than the payment on his first home, in almost every case. Many of the sales, probably the higher percentage in Vail, are bought for cash. But if the buyer has to finance it, he will be paying finance charges of about 2 to 4 points, financing about 80% at 9-3/4 or higher percent interest, for about 25 to 30 years.

The buyer must also decide what he's going to do with it after he gets it. About 25% of the condominiums bought will be rented, either on a nightly basis or on a monthly basis; 75% of the units will sit empty most of

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[1] Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

[2] Moore Realty and Brokerage Co., Dillon, Colorado.

the year. They will not be used by a renter, and they will be used very little by the owner, depending on how close he is. As a good example, I've never seen the owner of the condominium next to mine in Dillon and I've lived there two years! It's been sitting empty all that time, fully furnished. An agent is trying to sell it for $96,000. I would say it's worth about $115,000; it sold for about $90,000 originally without carpeting, draperies or furniture.

This is the type of individual who wants to buy a condominium today. When he finds out it's a tough proposition, he may get another family or two to go in with him. If they get much farther than that they're into J. J. Collins' program, time sharing.

We don't know if time sharing is going to work. Vail Associates in this area has been the most successful with it. There are horrendous problems we don't know about. One is management. Are these people buying time sharing really real estate buyers? The theory is that if you get it down to where they're paying $2,000 to $4,000 for a time slot you will increase your market. You may also increase your problems. You may be selling to people who normally buy cars and refrigerators, not real estate. If the owner of a financed condominium gets sick of coming to Vail every year, he may write you a letter after a year or two and say: You keep it! If you've gotten enough down, maybe you don't care!

Now, let's get a profile of the fellow who uses a condominium but doesn't own it; he rents it on a nightly basis. He flies out through Continental Airlines through the package plan Mr. Kelley has set up. He usually comes in about the 20th of December and stays through the 6th of January. Everybody wants to come at that time! But they fly in from Chicago, rent a car, and drive up to the mountains. When they leave Denver, the sun's out and it's beautiful, but when they hit Georgetown the road is icy and the snow's blowing. They have to wait 30-40 minutes to get through the Eisenhower Tunnel. They're going to stay six days in a nice condominium in Breckenridge. They have a four-day ski pass. They don't ski the first day, they unpack and get their nerves calmed down from the drive. They don't want to get back into the car again, they want to walk everywhere. But it's 31° below outside and the wind's blowing, so they get a drink and watch the Monday night football game or whatever is on TV. And they call their buddies in Chicago and tell them how rugged it is out here. The next day they go skiing for the first time, the first exercise they've had in months. If they survive, they add a little more to it the second day. The third day they rest and attend their wounds. They may ski one more day, then rest up before they pack to go home. So they ski about 3.8 days out of 6, they've walked to every place they've been, they haven't driven the car, and they go back telling everybody how really tough it is out here. It might be, because many of them break their legs, they get terrible sunburns, their muscles are just beat. But they have spent a lot of money.

Why did they come out here to torture themselves? Maybe they saw the President on television, or they thought they could escape from all the problems in the cities. People come out here to buy for those same reasons. Many people come to us and say, "I have been to Colorado for four or five years now, and I really enjoy this area; I want to get away from everybody." They don't realize we are having the same problems out here that they have in Chicago: we're just trying how to figure out how to solve them before they get too bad.

These are the users and the buyers today. We don't expect them to be much different tomorrow; we hope that all of us and the people who are involved in building and subdividing are a little smarter.

If you read the newspapers you would think we are in a deep depression in the mountains, that nobody's making a living, that we have condominiums completely empty everywhere. We do have some empty condominiums. A major reason is that, in January, 1974, over 6,000 units were completed in all of the ski areas at about the same time. We couldn't sell them fast enough. Probably in all the ski areas in Colorado, less than a thousand units a year are sold. The first question obviously is, Why didn't somebody plan better than that? Several factors contributed. What with adverse weather conditions and all the problems of getting started, construction of a condominium often takes about 18 months. In 18

months we've had Watergate, slow economic conditions, and problems with gasoline supplies. And 18 months ago you could sign a note for one and a half million dollars, agree to pay 18% interest to the banker, and the banker was happy to lend you the money; he had lots of it.

Say you were a lawyer, you had never built anything in your life, but you heard "they" were making a lot of money up in the mountains, so you had your architect friend draw up some plans. Your banker didn't even look at your plans. (This has actually happened.) He didn't go look at the site. You built the condominiums, even though you didn't know the first place about a condominium. You never asked anybody whether they could be sold. Now they are all finished 18 months later, when economic conditions are bad and you're paying 18% interest. The banker's getting nervous over the recession, and calls you every day wanting to know how many you've sold. So you come to somebody like me and say, "Here are these units, would you sell them?" Let's look at them: there's a vanity in each bathroom or next to the bathroom for you to wash your face. I'm not very big, but when I bend over, I can't brush my teeth because there isn't room enough to move my arm. The bedrooms have three walls against the three sides of the bed, but the living room is way too big. The kitchen has no windows, and a wife would be sick of the place in a week. The place has a parking garage with an open bottom, and all the pipes froze up on Christmas Eve.

All of these things are bad planning. Nowhere along the line did the banker say "Wait a minute, you're a lawyer, you don't know anything about building. Who's going to sell this for you? Does he know what he's doing? What kind of financing have you got permanently?" He gave you the money to build at 18%. Then when everything falls apart, the banker gets fired because he made a bad loan, the developer gets eaten alive by 18%, the realtor's dying because he doesn't have anything to sell that's worthwhile.

Yet, the airlines are upset because they've got thousands of people coming out here and nowhere to put them. The bankers won't let you use the units for rental because they don't want them to get damaged and dirty--a legitimate reason. So you have four, five, or six hundred empty condominiums sitting in Vail, Colorado. People are standing in line to get into Vail, but there's no place to put them. The papers are all writing about what a depressed area it is, and it really isn't depressed! We've got a combination of a lot of dumb people who did a lot of dumb things, and each is trying to figure out who ought to be the dummy! The problem is that, first of all, the lawyer should never have built them. But in easy money times, lawyers, doctors, school teachers, engineers, everybody becomes an expert in building. We can prevent such problems through the efforts of planning people and through the people who loan the money.

The thought I'd like to end up with is that the buyer is a good man. He's going to buy because he buys emotionally. He loves the mountains and he loves Colorado. It's a place to get away, where he can relieve his mind from city tensions. We're going to need more of that as time goes on. So we've got to do our best as planners and builders to give him a product that fits the environment and that is compatible with other public lands and uses, yet one that can be resold in the future, can be used, and can be a credit to the community. But it can't be done by one agency of the government, or one individual. Maybe it takes a catastrophe like the economy slowdown and a lot of empty units and a lot of bad subdivisions to get us all to realize that we have to contribute our part. Maybe our part is restraining some development, or advising other people what we think is best for that area, or doing some research to determine where we're going.

That's about who's going to buy in the future, and who's going to be the user. I did exaggerate slightly, but not much. What I've told you is really what we do every day.

Session I Discussion

Loren Potter, UNM: There is an obvious trend toward condominiums at ski areas. What are the pros and cons of the high-density, low-cost dormitory type of facility such as "The Night Latch" that used to be here at Vail?

William Sims: I'm familiar with The Night Latch because I was instrumental in having it torn down! I think it's the economic times. Dormitories in the early days were for young people. Many of them have switched to condominiums now for different reasons, some related to liberalism, to comfort, and to money. The cost of putting up a dormitory now is too high for what you can get out of it. Actually, even a condominium is a lousy investment for income purposes. If you rent it for the maximum number of days you could get, you would still come out short of paying all the costs of running it. It is a good investment, however, in terms of appreciation, the cost of building today versus the cost down the line.

Potter: I think business is overlooking a significant user group for ski areas. Couldn't you serve more people per square foot in that kind of a facility?

Sims: You might be able to serve more people per square foot, but would they want to pay for it? Would they come? Couldn't you serve them better in another type of facility? A $72,000 condominium sleeps six people and goes for $120 per night in peak season. That's $20 per night per person, but they don't have to buy restaurant meals.

Douglas Fox, RMFRES: Mr. Kelley, would you care to discuss the economics of the ski business for airlines; particularly, would you give some indication of how much money Continental, or airlines in general, spend on advertising?

Maurice Kelley: Any carrier will assess his route structure and figure out where the marketing opportunities are. In the case of Continental, Colorado ski country is an ideal promotional opportunity because it's contra-seasonal--July and August are our biggest months--so this gives us an opportunity to mount a major marketing effort in the winter. In our annual marketing plan, we build in a ski marketing program of about $250,000 to $300,000 worth of advertising effort in skiing magazines, business magazines, and so on. United says in the trade press it spends about half a million dollars promoting skiing. It's a major part of any carrier who serves Colorado.

Also, we work with other carriers, since we only fly here from Chicago and L. A. This past year we had Eastern Airlines, Delta, Piedmont, Allegheny, and American selling our Vail packages. They'd bring skiers into Chicago, where we'd put on extra sections--sometimes 3 or 4 extra planes on Saturday morning--to bring people here. It's a totally coordinated marketing effort, which can really build resort areas!

Question: What is the possibility of a Motel 6 type operation in this area, where people can stay for about $6 per night?

Sims: I think it would work if you found the right piece of ground. Operating costs would be higher, it's just impossible to get labor here at any decent price. The land itself might be a real problem, especially here in Vail. I think it would go in Dillon or any of the other ski areas.

An important point that we haven't considered is that it probably would go well in summer! You come into Vail on a summer day and people are milling all over the place. But at night the streets are deserted and the hotels are empty. Where did they go? Out into the National Forest to sleep in campers, tents, under the trees! We'd like to figure out a way to get them into the condominiums!

J. J. Collins: In Vail, people want to free themselves from the automobile once they get here. They want to be within walking distance or have some type of public transportation system to carry them from their sleeping facilities to ski lifts and eating places. But such close-in land in Vail is too expensive to support a Motel 6 type operation, so you move them out of town. Then they've either got to keep the automobile, which increases their per-day expenses, or the area has to provide them with a transportation system. Either way, there has to be a dollar trade-off!

SESSION II

SOCIO-ECONOMIC CONSEQUENCES OF DISPERSED AND CONCENTRATED HOUSING DEVELOPMENT

Chairman: James Osborn, Associate Dean
College of Agricultural Sciences
Texas Tech University

A. COMMUNITY AND REGIONAL COSTS

Coordinator: Charles O. Minor, Dean
School of Forestry
Northern Arizona University

B. COMMUNITY AND REGIONAL BENEFITS

Coordinator: James Gray
Department of Agricultural Economics
New Mexico State University

C. SOCIAL AND ENVIRONMENTAL PLANNING

Coordinator: Dennis H. Knight
Botany Department
University of Wyoming

Session II focuses on community and regional costs and benefits accruing from leisure property developments as well as social and environmental planning considerations affecting these kinds of developments.

The Rural Suburb: A Socio-Economic Overview[1]

Edwin H. Clark, II[2]

Some of the strongest support for and opposition to leisure home developments is stimulated by their supposed economic and social benefits and costs. Everyone associated with the industry, either as participant or observer, has some story to tell that supports his bias. And that seems pretty much to be the stage at which research on leisure homes is presently floundering--with stories which support one viewpoint or another. Most leisure home research has been directed at intensive case studies which at best will support episodic analysis. This approach helps substantially in making leisure home research conferences more interesting, for a war story will beat a regression equation every time, but it does not provide a great deal of assistance to those attempting to predict the impacts of the next development. Case studies rarely provide the type of information that allows one to define general relationships and identify critical parameters. One of the main questions that has to be answered is whether we know enough about these developments on the basis of all the case studies completed or underway to allow us to begin to generalize, to begin to develop some predictive tools.

I am not going to try to provide the answer in this paper. The purpose here is little more than to ask the right questions.

In asking these questions, I am going to be focusing on one small part of the whole recreational property industry. This industry ranges from raw land sales, which are often little more than a rather perverse form of gambling to intensive recreational developments such as Disneyland. This range includes campground developments and trailer developments, goes on to subdivisions when the homes are built by the lot buyers and through the fully developed leisure home subdivision where the developer not only subdivides the land but builds the houses. Most of my discussion will really be dealing with these last two types --legitimate leisure developments where the residences are either provided by the developer or are truly expected to be provided by the buyer in a reasonably short time.

These developments often differ very little from a typical suburban subdivision; they have similar densities, similar layouts, and similar problems. "Wilderness Acres" is often no more than a lonely "Executive Estate". Research on leisure homes should always be asking how the effects of these developments differ from the effects of any other subdivision. To the extent that they are similar, all of the research done on suburban development can be used to help understand leisure home developments. I will use this analogy in my own comments. But we should very carefully attempt to identify where the similarities and differences lie. Making these distinctions should be a basic focus of any leisure research.

Finally, most of my observations are based on a leisure home study sponsored by CEQ in association with HUD and the Appalachian Regional Commission. The results of this study, which was undertaken by the American Society of Planning Officials, the Conservation Foundation, the Urban Land Institute, and Professor Richard Raget, is being published this year. It includes an analysis of leisure home markets, the environmental, economic, and social impacts of such developments, and proposals for effectively regulating these developments.

With these general comments, let me get on with my overview. In this I will try to do three things. The first is to attempt to define a framework for identifying the effects we are concerned about. The second is to attempt to

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[1] Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

[2] Senior Economist, Council on Environmental Quality, Washington, D. C.

identify the primary factors which determine the magnitude of the effects. And the third is to summarize what I think we have learned about these effects.

An Impacts Typology

In any analysis of social and economic effects the basic questions which should be asked are where, whom, when and what.

Where do the effects occur? Probably the most meaningful distinction here is between those effects which occur at the local level, at the regional level, and at the national level.

Who is affected? For residential developments, one key division is among the new residents (or 'natives'), and non-residents. A second division would be according to income. A third would be according to occupation--for instance farmers versus merchants. Another would be property owners versus renters. Another would be consumers versus taxpayers. And so forth. Those are an unlimited number of ways of identifying the different groups that could be affected by the development. Most of these divisions, of course, overlap with one another. Every individual will fall into several of the separate groups identified. A person may be a native, a farmer, a property owner, and both a taxpayer and a consumer at the same time. The net impact of the development on this person will be an aggregation (which is not necessarily a simple sum) of the separate impacts upon him in these various roles.

When will the effects occur? Some occur before development takes place, some during the development period and others will occur in various forms after the initial development is completed and the development continues to mature and change. One of the major problems with case studies is that they usually provide only a snap shot in time. Even the Forest Service seems reluctant to sponsor long-term research projects--say for a period of 50 to 200 years--which would be necessary for a thorough analysis of effects over time. As a result, we tend to ignore this dimension of the analysis, although it is most important.

What effects are of concern? The following is a preliminary list of the types of socio-economic effects I think are important in studying leisure home developments. This initial list is sort of a casual integration of what I know about what we have found in past studies. The list will undoubtedly be modified by future research--some effects being added and others subtracted--but this list should serve for the time being.

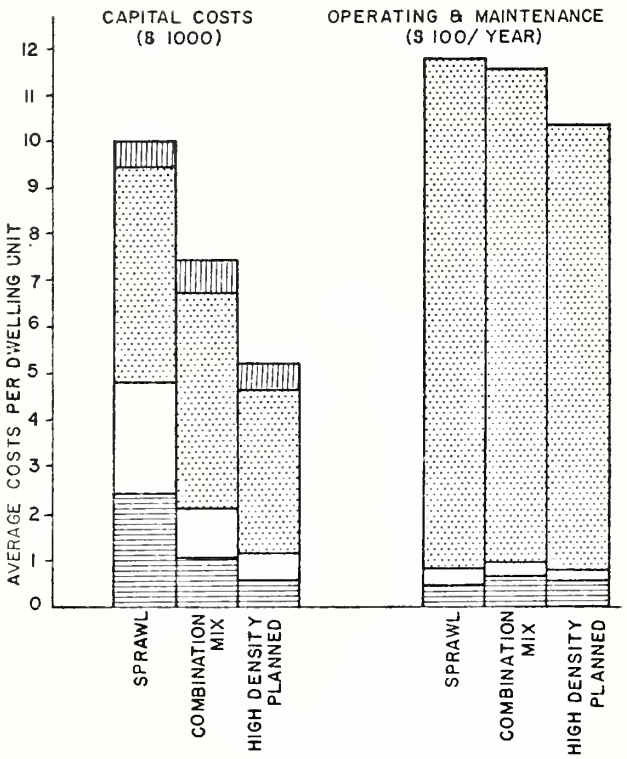
Economic and Social Effects

In terms of economic effects there are two major distinctions. The first is between impacts on incomes and impacts on costs (both taken in a very general sense). The second is between the impacts that occur in the market place and those that occur in the public sector. These are basically concerned with the direct and indirect tax revenues generated by the project compared to the direct and indirect additional costs of the public services it requires.

To help in identifying the specific cost impacts we should be interested in, it is useful to start by looking at government budgets and see how residential developments are likely to affect the different budget categories. Figure 1 attempts to do this for costs. Schooling is the biggest cost item in local government budgets, both in terms of capital and operating costs. Property tax, of course, is the largest source of local government revenues, but other sources are important as well. In the following section of the paper I will discuss which of these cost and revenue categories are affected by leisure home development.

It is less easy to identify the impacts in the private market which are of concern. Some of the relevant questions are how does the project affect monetary and non-monetary incomes, perhaps distinguishing on the monetary side among changes in wages, changes in profits, and changes in wealth. Changes in non-monetary incomes brings us perilously close to social impacts, so we will postpone discussion on those for a moment. Of course, even on the monetary side, we should be talking about real and not nominal incomes, which raise the question of how the development affects prices, or otherwise affects the costs experienced by household units in producing the services they consume.

Let us move on to discuss some of the non-monetary impacts and this will carry us over into social impacts--I am never sure where the division lies.



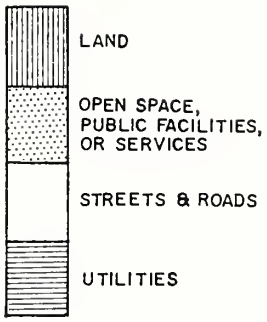


Fig. 1. --Public costs of different development patterns. Source: Real Estate Research Corporation, The Costs of Sprawl: Detailed Cost Analysis. A study undertaken for the Council on Environmental Quality, Department of Housing and Urban Development, and the Environmental Protection Agency (U.S. GPO, Wash., D.C., 1974).

The population growth resulting from a leisure home development will probably increase the cost of public and private services, but may also increase the quality of these services as well. For instance, the town may decide it is necessary to improve its fire protection by buying a new fire engine. The increased protection is available to the old as well as the new residents and this is a form of non-monetary income. Of course, services can get worse too, diminishing the non-monetary income of the original town residents.

The same is true of recreational opportunities. A new development may increase these in either of two ways. The developer may directly increase the available facilities, for instance, by building a lake. Or the facilities may be provided indirectly because the buying power of the new residents is sufficient to support, say, a bowling alley which will also be used by the original inhabitants. On the other hand, the development may cut off access to recreational opportunities traditionally enjoyed by the original inhabitants or may make the sites so crowded that the experience is considered less valuable.

Other such impacts of concern include the increased congestion associated with population growth, possible increased crime rates, a loss of political autonomy, the stresses often resulting from a new culture invading an old, and the problem that the original inhabitants may be forced to change their lifestyles and even leave the area where the development occurs.

This list is nothing if not incomplete. It attempts to make one point, however, and that is that these impacts affect the new residents as well as the original residents. And the impacts on the new residents can't be all that bad, for otherwise they wouldn't be coming and spending as much money on a second home as they are. This is a consideration we have to keep in mind as we bemoan the passing of the old. Another thing we should remember is that many of these impacts may have both positive and negative sides. New residents may well change the social complexion of a community. Is this destruction or reinvigoration? It is probably both.

Let us leave the typology at this point. We have listed a number of different social and economic impacts that may be of concern, and we have listed a number of different ways, under the three questions where, whom, and when, in which we should classify these im-

pacts. There are a lot of little boxes we have defined, too many to be filled by most research efforts. Luckily, lots of these boxes probably are not too important, although agreeing on which particular ones are unimportant is often very difficult.

Some Results

Having tentatively identified the types of effects that we think we should be interested in let me now briefly summarize what I think we know about the importance of these impacts. This is not going to be a rigorous fully footnoted and cited summary. Rather it is going to be more of a perhaps too casual integration of a number of different studies of development. For a more fully footnoted study I would refer you to the one referred to earlier, soon to be published by the Council on Environmental Quality in association with HUD.

What I am going to try to do now is present a brief capsule of my impressions of what this and other studies have found. It should provide at least a touchstone for the other papers to be presented in this session. My goal here is less to define the magnitude of the impact than to identify the most important factors determining that magnitude. To follow the pattern I've already set, let us start with economic impacts and first deal with those in the public sector.

Any development involves government costs. There are the investment costs involved in building roads, supplying sewers and water, and building government facilities to serve the population that is associated with the development. There are also the operating costs for police and fire protection, road maintenance, etc.

The factors which apparently most affect public investment costs are (in no particular order):

- Pattern and density of development
- Development controls exercised by local government
- Size of project and amount of development
- How the development is used (e.g., summer only, all seasons, permanent, etc.)

Leisure home developments are likely to be large. The average size of projects filed with the Office of Interstate Land Sales, HUD, is about 1000 acres. Much less is known about buildout rates. Some projects will probably never see a house. Others will be built up very quickly. In general, the more physical front end investment the developer supplies, the faster the buildout rate is likely to be. Even projects which have a low buildout rate can be expensive if the community has to provide services to widely scattered houses.

The importance of development controls is that it allows the government to ensure that the project is developed in such a way and to such standards that the government won't be stuck with supplying or upgrading much of the infrastructure for the residents.

The impact of pattern and density on investment costs was demonstrated in the CEQ publication The Costs of Sprawl.[3] The results of this study, summarized in Figure 1, demonstrate that higher density development[4] (i.e., walkup apartments and low-rise apartments), and clustering reduce investment costs per resident substantially. Investment costs from roads and utilities are 10 to 20 percent lower with clustering, and 40 to 60 percent lower with higher density and clustering combined.

The impact of infrastructure quality on cost is obvious: dirt roads are cheaper than paved roads. Some of these savings, of course, really represent no more than a transfer from investment costs to increased operation and maintenance costs.

How the development is used can have important effects. If the development is to be used during the snow season, better roads will have to be built and more money spent in keeping them open. Even more important,

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[3] Real Estate Research Corporation, The Costs of Sprawl, a report prepared for the Council on Environmental Quality, the Department of Housing and Urban Development, and the Environmental Protection Agency (Washington, Government Printing Office, 1974).

[4] The ranges of density covered in this report is from 1 2/3 to about 3 dwelling units per gross acre.

however, is the question of whether the development will be used as a permanent residence. If so, costs will be much higher than if it is used only for casual recreation. With permanent residents, roads may have to be upgraded, sewers provided, schools built, health care facilities constructed, and so forth. I will return to this question later. Finally, of course, the cost of the infrastructure is going to be substantially affected by the characteristics of the site, both geographical and climatic, and these vary widely from one development to the next.

Moving on the public service operation and maintenance costs, these are related primarily to the size of the population and the quality of the services provided. Development pattern and site characteristics are less important, although climate clearly affects some costs. There is little information about how these costs vary among small communities but there may be strong discontinuities. For instance, a small village may have no or a small, volunteer, fire department, but a sudden influx of population may force it to acquire better equipment and establish a paid department. The public costs would jump from very low to very high. As with investment costs, an important factor in determining these costs is the quality and amount of services required by leisure home developments.

Flipping to the other side of the ledger, leisure home developments also increase public revenues at the local level. The amount of increased revenued generated by the project depends on such factors as the balance between different revenue sources, the amount and type of development, how much the development is used, and how the local tax assessor reacts to the development. Concerning this latter point, if the land is worth $500 an acre in agricultural land but is sold to potential home builders at $25,000, the assessor has to decide how he will value the agricultural land which is not developed. If the assessor assumes that all of this land is also worth $25,000, then the farmers are going to pay a large portion of any increased revenues and the lot buyers in the development a relatively low proportion. On the other hand, if the assessor (as is often the case in rural communities) assumes that there are two different markets and the farming land is only worth what it pays as a farming land, then the new tax revenues will be shifted primarily to the new lot owners.

This gets to the question of who is going to pay the increased costs. Commonly it is the original community population that pays a high proportion of these costs. However, there are various ways that the costs can be shifted on to the new residents. One is through property assessment policies, as mentioned above. A second is by the community requiring the developer to put in most of the infrastructure or otherwise assume what are commonly public costs. The developer, of course, passes these costs directly to the buyer and they do not pass through the public sector at all. Finally, some of the costs, to the extent that they are subsidized by state or federal aid, will be paid by taxpayers who have nothing to do with the local community or the development.

A most important question in leisure home development is when these costs and revenues occur. One of the major conclusions of our leisure home study is that a leisure home development is really little more than an early suburb. The homes may be built initially in all expectations that they will be used for nothing more than a summer cottage or winter ski lodge; eventually, however, they will most likely be converted into permanent homes. In some instances this conversion process takes decades. Leisure homes in New England may not become permanently occupied for 50 years or so. In other cases, however, the conversion occurs instantaneously. Leisure homes being built outside Washington, D. C. are bought as first homes and settled on a permanent basis immediately. Even before the developments are finished, school buses are winding their way around construction equipment and through muddy roads picking up children of the first new residents. The important question then becomes not so much what will the costs be, but rather when will they occur.

A pure leisure home development does not require as high a level of services as permanent homes. Usually public revenues exceed public costs before conversion to permanent use takes place. However, as homes are converted to permanent dwellings the higher cost investments will have to be made, and public costs may exceed public revenues.

This raises one of the fundamental dilemmas associated with leisure home development. Should the developer be required to provide these high quality services from the beginning of the development or should the infrastructure be provided when it is actually required (perhaps with some attempts made to get the home owners to pay these costs at that time). If you accept the proposition that the developer should provide the services, you are implying that leisure homes cannot be bought by any but the very wealthy or by those who really want to use them as permanent homes. This is also not a very efficient solution. Some of the infrastructure will go effectively unused for many years and may deteriorate during this period. For instance, sewers will deteriorate whether they are used or not. If the developer has to install them decades before any building occurs, they may not be usable when they are needed. If so, the only thing that will have been accomplished is that the lots will be substantially more expensive, and there will have been a substantial waste of resources. On the other hand, allowing the development to occur to very low standards and then attempting to patch it up later can also be very expensive. And getting the residents of the development to pay the increased costs at the time they have to be made is often difficult. The local community may be faced with a dilemma to which there is no solution.

So where does this bring the assessment of public costs. Basically, my conclusion is that a community should review a proposed leisure home development as being a potential permanent subdivision and should expect costs and revenues accordingly. The critical issue is how fast is the conversion to a permanent subdivision going to occur? If it is expected to occur rapidly, then the community should require that the development be built essentially to suburban standards from the beginning. However, if the community believes that this conversion process will take a long time, this is probably an inefficient solution. The community should rather look at the expected flows of revenues and costs, when they will occur, and try to determine how it can place the burden on the residents of the development when the costs appear. In the meantime, the taxes paid by a project may exceed the costs of the services that the government has to provide that project until a substantial proportion of conversion has occurred. Could not this revenue surplus gathered during the earlier years be used to pay the increased costs which occur in later years?

Let us move now from the public into the private sector. There is always a hope in the host community that new development will bring new riches to the original population. The developer is usually not shy in promoting this expectation, painting vivid pictures of all the spending that will be done by the new residents, the employment to be generated by the development, and so forth. What actually occurs may be quite different. Research in regional economics tells us that a major factor determining the impact of a development on a local economy is the ability of the economy to provide the services required by the development. If the economy is small to begin with, the impact will also be small. A smaller proportion of the original expenditure will be made in the community, and the expenditure multiplier will be smaller.

Some of the other variables that affect the income generation include the size of the development, the income of the residents, and the amount of time the residents spend in the development. For the high quality developments in which the developer builds all the homes, much of the labor may be imported into the region if the developer has his own contracting force or is unable to find a local contractor who can undertake such a large contract. There will be some jobs available to local people but these are likely to be in lower paid, unskilled positions. Nor are the imported construction workers likely to contribute sufficiently to local economy. Many of them will be commuting to the site from residences far away. Construction workers commute 80 miles or more each way, rather than temporarily moving their families closer to the construction site.

After the new residents move in, their expenditures often are not as high as average household expenditures in suburban areas. They bring many of their needs from their permanent homes. In some cases their expenditures are high enough to generate substantially increased demands for goods and services, but even so, outsiders may end up benefitting. It may not be the old general store that sells all of the food but the new A&P built by someone out of state. Studies done in

New England have shown this to be the case in commercial development around skiing centers. If this does happen the local store owner can actually be hurt because he has stiffer competition than he had previously. Of course, the other side of the coin is that if stiffer competition results in lower prices, all consumers benefit.

In general, employment generated after the construction period is finished, is likely to be seasonal and low paid employment. Nor is the development likely to stabilize the economy of the small town. There will be economic growth, more stores, more income generated, but much of this growth may not benefit all of the people. I would be reluctant to justify a proposed leisure home development on the basis of its supposed local income generating effects.

Social Impacts

Social impacts are probably as important as economic impacts, but are much harder to quantify. We rely more on episodes. And I have my own episode to add. I used to live up in the northwest corner of Massachusetts, and had many friends and relatives who lived in Vermont. Like many I became fascinated with the old Vermont Yankee and was interested in the conflict between the Yankee and the immigrant, be he a leisure home owner, a hippie, or whatever. Many years ago a family moved to a small Vermont town to escape New York City. Like many, they had started by spending their summers there, but finally decided that they would give up some of their monetary income for the peace and quiet and beauty of a rural residence. And like many they loved their small town, and longed to be accepted as a part of it. One morning the wife was down at the old general store talking to Jake the store owner about how much she felt a part of Vermont and how much her family loved living there.

She said to Jake, "Jake I know that you Vermonters will never accept me as a native. I can never live here long enough for that to happen." Jake, like most Vermonters, would rarely add more than a simple "spose so" or "yap" to the conversation, so the woman went on:

"But Jake you know my son Paul."

"Yap."

"And you know he was born here in Vermont."

"Yap."

"Now, I realize that you are never going to accept me or my husband as natives, but how about Paul? Paul was born here just as much as your children were. Are you ever going to accept him as a Vermonter?"

"Well," said Jake, "you see the chair over there?"

"Yes, I see it."

"And you see that pregnant cat sitting there in that chair?"

"And you see that stove, don't you?

"Yes."

"Now tell me, if that cat were to jump into that stove and have it's kittens, you wouldn't call them biscuits would you?"

Now that story, apocalyptical or not, may pretty well summarize what we can say about social impacts. I will try to say a little bit more but I'm not really sure I'm going to succeed. The influx of new residents will change the life style of the natives. There will be more congestion--it will be harder to find a parking place, harder to get out of your garage. Life in the town will change. The new A&P may be cheaper, but it is bound to lack much of the personality of the old general store. The original inhabitants may well resent these changes. More likely, the early immigrants will resent them more. There will be other changes as well. Crime will likely increase, although crime is becoming a more serious problem in rural areas everywhere. The original inhabitants may find they have less control over what happens in their town and even or over their own lives. Because of the sudden influx of large numbers of strangers, the community solidarity may well deteriorate.

I have the theory about the progress of rural politics. Before the development pressure starts, the town is run by the old

merchant or farmer. However, as development pressure begins to build up, the spectator and real estate agent is likely to become more interested in taking the leading role. After development progresses the new residents who have settled there permanently will become more concerned about what is happening to the quality of life and make their effort to take over the town so that they can stop the growth--the old gangplank syndrome. The initial inhabitants lose control early in the process and may well resent being excluded.

But there may also be a number of social benefits to the original inhabitants. The quality of their life may well improve if their incomes go up. They may be able to afford better housing, better food, etc. If the new residents demand and can support better services, these better services will also be available to the original inhabitants. They may benefit from better schools, better hospitals, better police and fire protection. They may have access to a doctor where none was available before. All change has social impacts, some of them favorable, some of them unfavorable. It is clear that the quality of life will change. It is not clear whether it will improve or not. This depends to a great extent on the values of people, what they are accustomed to, and what they expect.

Cost to Public Land Agencies Resulting From Recreation Developments on Adjacent Private Lands[1]

David D. Chase and Theodore A. Hoff[2]/

Abstract.--Scant information exists on the source and magnitude of costs to public land agencies resulting from private land developments on adjacent lands. In this study management cost functions are developed and empirically tested with data from the Mogollon Rim Area of Arizona. The authors demonstrate the usefulness of this methodology as a forecasting and budgeting device for local level land managers.

INTRODUCTION

That there has been a dramatic increase in the development of private landholdings, within or adjacent to public lands, for recreation purposes is widely recognized. These developments have arisen for several important reasons. Environmental conditions in crowded metropolitan areas have caused people to seek clean, uncrowded and unspoiled lands for recreation retreats. A rise in disposable personal income combined with shorter working periods has enabled more people to take advantage of second homes. Inflation expectations has caused an increased demand for rural land resulting in soaring land values making the development of private lands potentially profitable.[3] Increased property tax burdens have added an additional impetus to reduce the quantity of land held by single parties. Natural resource characteristics such as climatic relief and the presence of lakes and streams have also been important demand factors.

Among the many impacts on wildland areas resulting from the development of private lands within or adjacent to National Forest boundaries is a substantial increase in the direct and indirect cost of managing nearby public lands. Scant information exists on the source and magnitude of these costs. However these costs are critical inputs for regional and community planners and resource managers in evaluating land use alternatives.

In this study the authors seek 1) to develop a generalized methodology for determining incremental cost functions which are associated with the higher National Forest management responsibilities caused by increased utilization of private enclaves for recreation developments; and 2) to show how the information derived from this study can be used by Forest Service personnel and other land management agencies in their planning and budgeting procedures. In order to accomplish these objectives, specific cost functions are estimated from sample data gathered from the Mogollon Rim area of Arizona, imputations to a general universe are made, and the applicability of this framework to local level land managers is explained and assessed.

BACKGROUND

A unique wildland that has received more than its share of recreation oriented "people pressure" is the Mogollon Rim area of Arizona. This area encompasses portions of the Tonto, Apache-Sitgreaves, and Coconino National Forests. The land lies within parts of northern Gila County, southwestern Navajo County, and southern Coconino County in Arizona. Within the study area there are almost 66,000 acres of land in private ownership. In 1972, 8,000 acres of this had been recorded as being dedicated to subdivisions. There are approximately 150

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[1]/ Paper presented at the Symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

[2]/ The authors are respectively Associate Professor of Finance and Assistant Dean, and Assistant Professor of Economics, College of Business Administration, Northern Arizona University, Flagstaff.

[3]/ Doane's Agricultural Report, "Farmland Price Trends", Vol. 38, No. 31-5, Aug. 1, 1975.

different subdivisions, which include 16,555 lots ranging in size from less than one-quarter of an acre to over four acres.

The recent publication of the Mogollon Rim Land Use Planning Study (MRLUPS) included important work by Lindquist (1972), Boster and O'Connell, and Thompson and Lewis. The MRLUPS provides a timely and complete compendium of the socio-economic and natural resource characteristics of the Mogollon Rim. The Boster and O'Connell study yields significant information on the economic base of the Mogollon Rim area, including employment multipliers. Perhaps the most important characteristics of this area are: 1) its reliance on export employment, and 2) the dominance of the lumber industry, transient recreation trade, state and federal government activity and pensioneers or second-home industries in the area. Boster and O'Connell's work provides demographic insights on the nature of the population utilizing private lands in this study area. Since the economic base of this region is fairly narrow, it is not difficult to see why second homes or transient populations are important to this area's economy.

The Thompson-Lewis study is a most significant research document relating the effects of rural residential development on private land in the southwestern United States. Thompson and Lewis attempt to determine the extent of private land development in the Mogollon Rim area and "to indicate the probable impacts on land management alternatives" that accompany such developments.[4]/

This study seeks to extend the Thompson-Lewis study on the Mogollon Rim's socioeconomic characteristics by developing a methodology for measuring the incremental costs to the Forest Service associated with second home-recreation type developments.

METHODOLOGY

Physical Characteristics of Subdivisions

For the purposes of this study the Thompson-Lewis data, which is complete through 1972, is assumed to be current and that no material changes in the physical characteristics of subdivision developments within the study area have occurred within the last two years. Given the scope of the recession of 1974-75, and a post study sampling of subdivision activity by the authors, we are convinced that the data collected by Thompson and Lewis remain valid.

In order to develop quantifiable indicators of the size of subdivisions, the density of their populations, and their distance from neighboring metropolitan communities, the following statistical data was used from the Thompson and Lewis study: 1) the legal description by county, township, and range of the subdivision; 2) the number of lots in the subdivision; 3) the number of permanent houses in the subdivision; 4) the assessed valuation of the land; 5) the assessed valuation of the improvements; 6) the number of lots sold; 7) the number of second homes, and 8) the number of acres in the subdivision. Each subdivision was plotted on a master map of the study area to provide locational perspective. An additional statistic, the number of miles to the nearest major community, was calculated.

Forest Service Management Costs

Preliminary discussions with the Forest Supervisors of the National Forests within the study area indicated that the District Rangers were best able to identify the costs incurred by the National Forests that are associated with rural land developments. Accepting this advice, the study area was divided into Ranger Districts. The Ranger Districts involved in this study are the Long Valley and the Blue Ridge Districts of the Coconino National Forest, the Payson and the Pleasant Valley Districts of the Tonto National Forest, and the Heber District of the Apache-Sitgreaves National Forest.

A cost questionnaire and definitions to accompany the cost questionnaire were prepared with the help of the Flagstaff District Ranger from the Coconino National Forest. All categories are considered traditional costs associated with the functional areas of ranger districts. Included in these cost categories are trespass, special use permits, facility use and wildlife depletion, fire danger and control, insects and disease, timber harvest, watershed management, transportation management, and air, natural beauty, and open space. It should be noted that many of these categories were singled out by Thompson and Lewis as being potential problem areas in managing public lands in and around which there is a high potential for rural subdivision growth.[5]/ This study utilized the definition sheet to minimize the ambiguities associated with terminology, establish response parameters, and consequently increase the probability of more reliable cost information.

A letter introducing this study to the District Ranger was sent two weeks prior to the mailing of the cost questionnaire and the accompanying definitions. Each Ranger received

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[4]/ Lindquist, and others. 1972, p 89.

[5]/ Ibid., p 103.

a cost questionnaire for every subdivision located in his Ranger District. Shortly after the mailing of the questionnaires to the Rangers, the research team traveled to each Ranger District and conferred with the Ranger and his staff regarding problems of interpreting questions and of filling out questionnaires for particular subdivisions.

During these visits it became obvious that the Rangers included a number of subdivisions located within a close proximity to each other as a homogeneous management unit; it became impossible to completely differentiate costs by subdivisions. When individual subdivisions could not be disaggregated from a management unit, the Ranger or his staff officer was instructed to fill out the questionnaire on a management unit basis. The final statistical results of this study relate the costs to the National Forests associated with servicing the set of subdivisions located within 33 traditional Forest Service management units.

The management units, as established by the district rangers, varied in size fron 5 acres to 2136 acres. The distribution of these units was highly skewed toward smaller acreages with 29 of the 33 units encompassing less than 450 acres, two of about 1000 acres and the remaining two of about 2000 acres. The largest four units were removed from the sample in order to provide more homogeneous data with the goal of yielding better cost functions at little reduction in sample size.[6]/

STATISTICAL MODEL

The basic hypothesis of this study is that a set of cost equations for estimating the costs to the National Forest Service associated with increased utilization of private lands for recreation and second home development can be derived via multiple regression.[7]/ Specifically, $C_i = \beta_o + \sum_{j=1}^{n} \beta_{ij} X_j$, i=1, - - - m, j=1, - - - n, where C_i is the type of management cost to the United States Forest Service as previously described and X_j's are the physical characteristics of a particular management area as given by Thompson and Lewis. The composite hypothesis can thus be stated as:

$H_{oi}: \beta_{ij} = 0$, for all i=1, - - m, j=1, - - n.

The computer program used in the analysis was the SPSS package (Nie, Bent and Hull, 1970) with specific applications of the step-wise regression and the partial correlation models of the package. The tests of significance of the individual Beta coefficients are as defined by Neter and Wasserman (1974).

STATISTICAL RESULTS

The independent variables (X_j) to be used in the regression model are shown below. The set of observations for these variables for each management area was adopted from Thompson and Lewis.[8]/

Variable Name	Variable Number	Unit of Measurement
County	VAR 12	Dummy Variable
Distance from town	VAR 13	Miles
Number of lots in management unit	VAR 14	Units
Average lot size	VAR 15	100 sq. feet
Houses	VAR 16	Units
Mobile homes	VAR 17	Units
Rentals	VAR 18	Units
Land value	VAR 19	$1,000
Improved value	VAR 20	$1,000
Lots sold	VAR 21	Units
Number of second homes	VAR 22	Units
Acres in management unit	VAR 23	Acres
Average value of a lot	VAR 24	$1,000
Average value of improvements total subdivisions	VAR 25	$1,000
Ratio of lots sold to total lots	VAR 26	Percent

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[6]/ Preliminary statistical analysis indicated that inclusion of all 33 management units reduced the R^2 values considerably.

[7]/ While several alternative models were attemtped, the authors accepted the multiple regression approach as yielding the best results. Further work with Log transformations are underway in order to test for economies of scale.

[8]/ Lindquist, and others., 1975, pp 88-105.

Ratio of second homes to lots	VAR 27	Percent
Ratio of houses built to numbers of lots	VAR 28	Percent

Table 1 shows the cost equations that were estimated after removing the four largest areas. These equations exhibit coefficients of determination and reliability in the regression coefficients which are reasonable. It is interesting to note that, for several of the specific costs, different sets of independent variables produced almost equivalent regressions. This phenomenon was most evident in the trespass cost estimates, which resulted in four equations with essentially indentical R^2, F-statistics, constants, and error terms. In each of the four trespass cost equations there were 2 significant regressors. The first one involved the number of lots in the management unit (VAR 14) and the average value of improvements in the subdivisions (VAR 25); the second, the number of lots sold (VAR 21) and VAR 25; the third, the improved value (VAR 20) and VAR 25; and the fourth, the number of second homes (VAR 22) and VAR 25. VAR 14, VAR 20, VAR 21, and VAR 22 are highly correlated (all R_{ij}'s $\geq .95$), which explains the great similarity of the equations.

An important result of the removal of the largest management areas was that the coefficient of determination (R^2) of specific costs became much larger than that of the aggregate cost estimate (equation 1). This suggests that the best method of estimating aggregate costs for budgetary purposes, would be to estimate specific costs and add the results. This is intuitively appealing when considering that different specific costs may well depend upon different characteristics. For example, fire control cost, one of the major and most easily identified costs to the Forest Service, does not show up with a significant cost regression function. The implication here is that fire control is not dependent on the characteristics of the management units, but rather depends upon terrain, logging slash buildup, type of ground cover, and other variables not included in the study. Since fire control is a cost included in aggregate cost, this would also explain the decrease in R^2 for the aggregate cost function as compared to the other specific cost functions.

CONCLUSIONS AND POLICY IMPLICATIONS

The composite null hypothesis consisted of 10 simple hypotheses relating to aggregate cost and the nine specific cost categories. In two cases, fire control cost (VAR 05) and transportation management cost (VAR 09), the null hypotheses were accepted. The remaining eight null hypotheses were rejected. Regression equations for estimating costs were derived that were statistically significant at least at the 95 percent level, and in most cases at the 99 percent level, with respect to the F-test for the equations. These results suggest that a set of fairly reliable cost equations are available for Mogollon Rim Area district rangers to use in estimating budgetary outlays for a forthcoming fiscal year. The fact that these equations contain two and at most three explanatory variables minimizes the numerical manipulations involved in their application.

An example of how a ranger might utilize these equations is as follows. Assume that the ranger in the Long Valley District of the Coconino National Forest wants to estimate the costs of trespass on his district resulting from the Clear Creek Pines subdivisions. The nine subdivisions in Clear Creek Pines are treated by the Long Valley District as five management units.[9] The first trespass cost equation indicates that the number of lots in the managements units (VAR 14) and the average value of improvements for the subdivision (VAR 25) are the relevant explanatory variables. In these five management units the ranger will find 1148 lots (VAR 14) and $3,775 of average improved value (VAR 25).[10] These values are aggregated over the five units. Applying the trespass cost equation using the data given above yields the following result.

$$\text{Trespass Cost} = \beta_o + \beta_{14}(X_{14}) + \beta_{25}(X_{25})$$

$$= 74 + .39(1148) + 4.45\ (3.775)$$

$$= \$538.52$$

The same variables (14 and 25) apply to estimating the cost of special use permits (equation 6).

$$\text{Special use cost} = 71 + .63\ (1148) + 3.48\ (3.775)$$

$$= \$807.38$$

These equations are useful also in pointing out situations where the costs to manage for certain characteristics is negligible. For example, the cost to control insects and disease (equation 11) will be realitively insignificant

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[9] Interview with Long Valley District Ranger, 1974.

[10] Note that while the dollar amount of the average improved value of the subdivision is $3,775, the regression equation is written to accept this term in thousands. Thus the dollar amount enters the equation as 3.775.

Table 1.--Estimation Equations

Equation #	Cost	Independent Variables			R^2	F	Intercept	$S_{\bar{y}}$
1	01	VAR	22	28	24	.35	4.45**	1290	1638
	Aggregate Cost	β	4.77	-3500	340				
		σ	3.38***	1.66*	307				
		t	1.41	2110	1.11				
2	01	VAR	21	28		.33	6.3***	1837	1632
		β	3.81	2597					
		σ	1.17	1951					
		t	3.26***	1.33*					
3	02	VAR	14	25		.42	9.51***	76	235
	Trespass	β	.39	4.45					
		σ	.12	1.47					
		t	3.25***	3.03***					
4	02	VAR	21	25		.42	9.51***	76	235
		β	.54	4.91					
		σ	.17	1.48					
		t	3.18***	3.32***					
5	02	VAR	20	25		.42	9.33***	79	237
		β	.39	4.53					
		σ	.13	1.47					
		t	3.00***	3.08***					
6	03	VAR	14	25		.63	22.5***	71	196
	Special	β	.63	3.48					
	Use	σ	.10	1.22					
	Permit	t	6.3***	2.85***					
7	03	VAR	21	25		.61	20.5***	74	203
		β	.85	4.21					
		σ	.15	1.27					
		t	5.6***	3.51***					
8	04	VAR	14	24		.43	9.74***	-26	95
	Facility	β	.23	19.31					
	Use	σ	.05	16.9					
		t	4.6***	1.16					
9	04	VAR	16	26		.42	9.3***	62	96
		β	1.39	-67.81					
		σ	.32	50.35					
		t	4.34***	1.35*					
10	05								
	Fire Control	Not Significant							

11	06	VAR 19	28	.47	11.7***	-24	26
	Insects &	β .06	59.46				
	Disease	σ .01	31.44				
		t 6.00***	1.89**				
12	06	VAR 20		.45	21.9***	-2.4	26
		β .065					
		σ .014					
		t 4.64***					
13	06	VAR 16		.41	18.85***	-3.6	27
		β .39					
		σ .09					
		t 4.33***					
14	07	VAR 21	25	24	.67	16.8***	-34	56
	Timber	β .278	1.13	27.11			
	Cost	σ .042	.356	9.86			
		t 6.62***	3.17***	2.75***			
15	07	VAR 14	24	25	.65	15.4***	-39	58
		β .20	30.42	.896			
		σ .032	10.31	.364			
		t 6.25***	2.95***	2.46***			
16	07	VAR 22	25	24	.65	15.3***	-36	58
		β .32	1.15	27.44			
		σ .051	.368	10.21			
		t 6.27***	3.125***	2.69***			
17	08	VAR 24	13	.21	3.48**	1.25	49.3
	Watershed	β 21.07	-4.29				
		σ 8.81**	2.06				
		t 2.39	2.08**				
18	09						
	Transportation	Not significant					
	Management						
19	10	VAR 23	27	.64	23.5***	-77	60
	Natural	β .64	73.70				
	Beauty	σ .09	31.98				
		t 7.11***	2.29**				

* Significant at 90% level
** " at 95% level
*** " at 99% level

in a ranger district's budget. For the Long Valley District land values, VAR 19, were estimated to be $1,314,000 over all five Clear Creek Pines management units. VAR 28, the ratio of houses built to the number of lots, averages 12% for the five units.

Thus:

$$\text{Insect and Disease Cost} = -24 + .06\ (1{,}314) + 59.46\ (.12)$$

$$= \$62.19$$

The utility of this analysis is even more apparent when one attempts to forecast probable costs when the subdivisions in question are fully developed. For example, assume with special use permits (equation 6) that the average improved value per subdivision was 100 times greater than it presently is (eg. $377,500 instead of $3,775). Special use costs to the Long Valley District due to higher improved values in Clear Creek Pines subdivision would increase to $2,107.94 or a change of $1,300.56 for a 100 times increase in average improved value. This result indicates that the marginal cost of the special use activity to the Long Valley District resulting from a 100 times increase in the average improvements of properties in Clear Creek Pines Subdivisions is, on a dollar basis, not great. On other ranger districts the results may be vastly different depending on the unique characteristics of the individual ranger district.

RECOMMENDATIONS

This study, being limited in scope, raised more questions than it answered. A principal question of whether costs are strictly a linear function of the independent variables in the study or whether economies of scale exist was implied by our removal of the four largest management units from the study. The appraisal of ranger's responses to the cost questionnaire indicates that a ranger either vastly underestimates the cost of dealing with large units or intuitively realizes the advantages of scale. This is an important question in terms of Forest Service policy with respect to concentration of private land within the Forest. If economies of scale do exist, Forest Service policy should perhaps be aimed at concentration of private land through appropriate trading practices, special use permit policy, and the like.

The study revealed that the rangers sampled had never attempted to evaluate the costs to support rural subdivisions which are "on the Forest." It is the author's feeling that the ranger's estimates were low! Thus the cost equations of this study yield low answers. Through experience and time however, these estimates should begin to yield more precise cost data.

Another aspect that needs to be examined is the geographical location of private home developments within the forest, considering such factors as terrain, proximity to established towns, the physical effects on surrounding forest land, and the availability of utilities (principally water and electric service). The Forest Service may improve its stewardship of the forest resource by actively promoting development at selected locations and discouraging development at other locations.

This study indicates that the development of enclaves within National Forests results in an increase in costs of operation for the Forest Service. Effective planning and budgeting must reflect and provide for these costs if the Forest Service is to maintain or improve its ability to manage the forest properly. Forecasts indicate that the number and size of these developments is going to increase over the coming years, thus the burden on the Forest Service is going to increase over time. This study has formulated a means of estimating the cost impact of these developments in the Mogollon Rim area. The methodology employed should be applicable to other areas of the National Forest in Arizona as well as in other parts of the country.

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The Mountain Property Owner: His Values, Goals, and Problems[1]

R. Burnell Held and Charles F. Robinson[2]/

Abstract.--Values, objectives and problem perceptions of owners of mountain properties within national forest boundaries were determined. Although land uses on private lands and the forest are not in complete harmony, areas of common interest offer hope for resolving differences.

INTRODUCTION

Second-home residences in the Colorado Rockies take a variety of forms, from the costly condominiums of the ski resorts to a simple, summer-use cabin, or even a house trailer parked on an undeveloped lot. The time of use varies as well as the type of use. The motivations for purchasing the properties may be much the same but the attitudes and values of these property owners can be expected to vary. New problems are created for local government and for adjacent land owners as mountain lands are converted from ranch and agricultural use to residential use. The attitudes and desires of the new owners and users may be quite different from those of the former owners and users. Where the properties are within the boundaries of a national forest, this change in ownership and use is especially important to the personnel of the United States Forest Service.

The most accessible and buildable of the privately-owned lands in the Colorado Front Range have long been converted to residential use. In many areas, houses and cabins which were built originally only for seasonal use have been winterized and are used as year-round residences. With structures in the canyons and on the mountain sides, one must travel far to find a relatively undeveloped forest landscape. Even within the boundaries of a national forest one will find development. While the Forest Service at one time leased tracts to persons desiring to build summer homes in the forest land, this policy has been largely discontinued and in some areas, existing homes have been removed. Thus, the developments which are encountered in the forests are usually those which are built on former mining claims, or on one-time forest homesteads. Under the Forest Homestead Act of 1906, lands within established national forests were made available to those desiring to homestead them providing that the land was chiefly valuable for agriculture, not needed for public purposes, and could be occupied without injury to the forest.

DEVELOPMENT ON THE ROOSEVELT NATIONAL FOREST

The Roosevelt National Forest, lying north and west of Denver, primarily in Larimer County, is a forest with substantial inholdings of private land. These inholdings are not uniformly distributed throughout the forest but tend to be found in the broader valleys, at lower elevations, and in the eastern portion of the forest. However, even the more remote areas of the forest have such inholdings.

One of the relatively remote areas of the forest is the watershed of the Little South Fork of the Cache la Poudre River. In this 67,705 acre area, only 3.4 percent of the land, or 2,302 acres, is in private ownership. Sixty three percent of the private land, or 1,449 acres, is held in tracts of 40 acres or more. The remaining 853 acres are divided among slightly more than 100 owners who, in most instances, have acquired ownership since 1960.

1/ Paper presented at a symposium, Man, Leisure and Wildlands: A Complex Interaction, U.S. Forest Service, Vail, Colorado, September 17, 1975

2/ Dr. Held is Professor of Recreation Resources and Mr. Robinson was formerly Graduate Research Assistant, Colorado State University, Fort Collins, Colorado.

These properties are 90 to 120 minutes driving time from Ft. Collins, the nearest source of supplies and medical aid. Denver is an additional 70 minutes or more away. The best of the two routes into the area, although a paved highway for 35 miles, continues thereafter as a gravel road with a much steeper grade. The gravel road is not maintained during the winter and portions of the road are usually impassable by mid-winter.

The character of the area has undoubtedly determined the type of purchaser who has bought property there. The remoteness of the area, winter road conditions, and elevations of 8 to 9,000 feet make it less attractive than other areas for a year-round residence. The nearest school is at least ten to twelve miles away over mountain roads and over a high pass. There is no resort development in the watershed although a small church camp is located there. The area has little potential as a developable ski area. It does offer attractive views of snowcapped mountains in the summer, many opportunities to camp, fish, and hunt in season, trails into the high country of Rocky Mountain National Park and relative seclusion. Perhaps one of the major attractions is that the lots usually back-up against the national forest and the lot owner, even on a small lot, can enjoy that land and can be reasonably certain that this part of his view and general environment will change relatively little.

There is an understandable concern on the part of national forest personnel as they see properties which were once put to uses which were highly compatible with the management of the forest converted to uses where there is less likelihood of harmony. While the Forest Service has a long history of issuing special use permits for the construction and occupancy of summer homes in certain areas of the forest, the decisions relating to the size, location and terms of occupancy are made by the Forest Service. In the new residential areas these decisions have been made without consultation with the Forest Service and with seemingly no concern for whatever impacts such development might cause.

The catalog of ills that can accompany the conversion of mountain land to residential use is lengthy. There are the hazards to human life and property: avalanches, landslides, fire, and to some extent, floods. There are the ever present problems of waste disposal and the inadequacy or the failure of conventional methods in mountainous locations and the costly alternatives. There are the increased silt loads in streams from disturbed areas such as roads and building sites, the loss of wildlife range and habitat and disruption of migration routes, increased traffic with its noise and dust in formerly quiet areas, and an increase in landscape scars where new roads and utility rights-of-way are pushed through. And then there is increased demand, at least from some of the new land owners, for public services which are costly to provide in remote areas.

The problems that accompany the conversion of private lands from an extensive to an intensive use are largely a reflection of the increased number of people in the area and the greater degree to which the land must be disturbed to permit the construction of roads, houses, and related improvements. Trespass on forest land occurs, and whether in innocence and ignorance or as a deliberate act, this increases the administrative burden on Forest Service personnel.

OBJECTIVES OF PURCHASERS

The new neighbors deep in the forest may raise other problems for the forest manager in the future. What were the objectives of the purchaser of the tract of mountain land when he bought? What were his expectations with respect to changes in the area over time? What were his perceptions of the role of the Forest Service and its personnel in the management of the forest land? These are questions which should also be of concern to the forest manager. With some understanding of the values, objectives and perceptions of the purchasers of such lands, there is the possibility of finding ways to harmonize the two types of land use in the area, particularly if the differences in values should not be as great as they may appear to be initially.

Of the 102 owners of properties of less than 40 acres who were identified, 80 responded to a mail questionnaire. Information was obtained concerning the year of purchase, some of the factors which were important in the decision to buy, the type and extent of use that has been made of the property, and problems relating to the property that have arisen. County records indicated that there was virtually no small-parcel real estate activity in the watershed during the ten-year period of 1955 through 1964. Twenty-eight percent of the initial sales after the larger tracts had been subdivided took place during the 1965-1969 period and 71 percent occurred from 1970 through 1974. Not included in these figures, however, is the resale activity. It was not intended originally to investigate this. However, in the process of communication with what were thought to be current owners, based on the most current records available, thirteen properties of the 102 were found to have new owners.

The properties, for the most part, are owned by local people or people living within a radius of three hours driving time from the study area. Forty-six percent are Larimer County residents; 35 percent are from the Denver-Boulder metropolitan area; 5 percent are from other parts of Colorado and many of the remaining 14 percent are out-of-state owners. The out-of-state owners, however, appear to be largely people who bought the property while living in Colorado and who later moved to another state. There was no direct information on this in the questionnaire. The only evidence of this was from other information supplied by the respondents.

Sales efforts appear to have been oriented to people in the locality and region rather than to out-of-state buyers. All buyers who responded indicated that they had examined the property before buying it but for 46 percent of the respondents, the Little South Fork area was the only area they had looked at. What was it, then, that attracted them to this area? Respondents were asked to rate eleven different characteristics of the area that might have been a consideration in their decision to purchase the property. If an unlisted factor was involved, the respondents were invited to indicate it as well. They were then asked to rate the importance of each factor in their decision to purchase the property on a 5-point scale ranging from"extremely important" to "not at all important." Similarly, they were also asked to indicate the purpose of the purchase. Recognizing that several purposes might be involved, they were also asked to rate the relative importance of the different purposes.3/

The responses to these questions indicate two characteristics of the area were of greater importance than all else: the scenic quality of the area and the private, uncrowded condition that they found there. Subsequent comments volunteered by the respondents reinforce this. The considerations which were of least importance were the purchase of property there by friends, property improvements, the subdivision plan, presence of utilities, and nearness to residence of the buyer.

When asked about the use they expected to make of the property, vacation use was ranked slightly higher than weekend use. Given much less importance than either vacation or weekend use was its use as an investment. Rated close to this was use during retirement. Next, with an extremely low score, was use of the property for a permanent home. From these responses it seems clear that getting away from everything in their everyday life for brief periods to enjoy the mountain scenery and environment in relative seclusion would most accurately describe the motives and values of the typical respondent when the decision to purchase the lot was made.

Of the 80 respondents, 29 or 36 percent, reported that they had a house or cabin on the property. Eleven of these respondents had purchased the property with the improvement already upon it.4/ House construction was underway on six additional properties at the time of the survey. Thirteen owners reported that they have been unable to fulfill their plans to build a dwelling or add other improvements, largely because of financial constraints. However, distance from the property as well as time constraints and the difficulties of access to the lot have also held up plans. Fourteen other owners indicated they expected to sell their unimproved property while another 14 expected to keep their land but did not expect to build immediately. Thus, it appears that even with the subdivision lots largely all sold, the change in the appearance of the landscape will be relatively slow. This is important for it presents an opportunity for the Forest Service to work with land owners in the development of their properties so as to minimize as much as possible the adverse affects of development.

Specific information about landowner-Forest Service relationships was sought in the study. Almost 82 percent of the respondents indicated that the fact that the property was an enclave within the national forest was an important factor in their decision to buy. Twenty percent, however, had objections to uses that were being made on the forest or certain management practices. These concerns involved the tree kill by bark beetles and a concern that the trees on their property would also be killed, road problems, problems of public trespass (the prevention of which is not a Forest Service responsibility) and miscellaneous complaints.

3/ The five levels of importance were reduced to two in the analysis with the number of responses in the middle category divided equally among "important" and "not important." Then, the individual reasons were ranked according to the number of respondents who had checked them.

4/ As indicated earlier, 13 properties had changed hands since subdivision had taken place. Thus, nearly 85 percent of the properties that changed hands had been improved at the time of sale. This contrasts sharply with the overall rate of building in the study area.

While relationships with the Forest Service, as seen from the point of view of the respondents, are largely positive, this situation could easily change as more of the property owners complete dwellings on their properties and begin to spend more time in them.

PROBLEMS IDENTIFIED BY PURCHASERS

The fact that the area is not accessible during the winter was a concern of 62 percent of the respondents who wished to have the roads kept open. While 12 percent had expressed no position on the question, 26 percent of the respondents were opposed to keeping the roads open. They argued that such an action would lead to even greater use pressure in the area from the general public, that the cost would be prohibitive, and that the stress on the ecosystem would be greater. Not mentioned in this regard, but of significance, is the fact that some of the subdivided areas are important elk winter range areas and an increased amount of human activity in the area could have a detrimental effect on the elk.

The responses to a question soliciting reaction to various types of development other than single family residences in the area, together with the emphasis given to scenic values and an uncrowded environment, suggest that the Forest Service may be able to find common ground with the lot owners by stressing the importance and the need for cooperative action in an effort to maintain as high a quality of environment as possible.

Landowners were also asked to state their opinions as to what the general area near their properties would be like in five years. The response choices were "get better", "stay the same", "get worse" and "don't know." Of those responding to the question, only 16 percent thought the area would get better. Thirty-four percent thought it would stay the same. Thirty-six percent thought it would get worse. Fourteen percent said they did not know. They were also asked to indicate what would be responsible for the changes they anticipated. Those who expected an improvement defined it in terms of improved roads, the construction of buildings on the currently empty lots, and better forest management practices in the area. On the other hand, those who anticipated a deterioration in conditions for the area cited a greater number of people and cabins in the area, heavier traffic, more noise, an increase in trespass and incidents of vandalism, poorer forest and wildlife management, and higher property taxes.

Compared with other areas, activity in the study area is still in the developing stage, but the landowners have been there long enough to encounter situations not to their liking. The following 13 concerns were those most frequently mentioned with the first two mentioned by 68 and 64 percent of the respondents respectively:

trespass and vandalism
poor road construction or maintenance
deteriorating natural surroundings
high level of traffic
inadequate fire protection
inadequate sewage disposal systems
lack of or poor utilities
over crowding--neighbors too close
inadequate water supplies or wells
difficulties in obtaining building permits
uncontrolled subdivision activity
decline in water quality
undesirable neighbors

The last eight problems in the list were seen as being important by a smaller percentage of the respondents, ranging according to the problem mentioned, from 17 to 29 percent of those responding.

There is a lack of concensus about some of these matters, however, as shown by some of the additional comments which the respondents volunteered. Some, for example, would like to see building standards relaxed because of the added cost involved. Why, asked one respondent, is a 25 foot road required when a 12 foot road will do? Why seek fire protection when it is less expensive to let it burn? Why be concerned with sewer systems when an outhouse with a concrete vault will do? Why worry about wells when water for cooking and drinking can be hauled in from town and water for washing can be taken from the stream? All landowners do not share these feelings, at least to the extreme of this particular owner.

When asked to identify the persons, or agencies responsible for the existence of these problems, replies were as indicated in Table 1.

One does not have to accept the accuracy of the perceptions of the landowners as to the causes of their problems but these perceptions are nevertheless important. The Forest Service now has neighbors that feel it should provide them with improved roads and better fire protection and that the Forest Service should do something to reduce the traffic into the area and take care of the natural surroundings that the new neighbors feel is deteriorating with the Forest Service being a major cause.5/

5/ Criticism centered on the abuses of certain areas by vehicles, excessive use of campgrounds, and the loss of trees due to bark beetle infestation.

Table 1. Problems in the subdivision perceived by property owners and the agents most frequently blamed for them

Problem	Frequency	Perceived Causal Agents and Percent of Responses
Poor road construction or maintenance	55	County 41.8 Forest Service 25.5
Deteriorating natural surroundings	37	Forest Service 35.1 Self and Neighbors 18.9
Trespass or vandalism	35	Public 57.1 County 22.8
High levels of traffic	27	Others 29.6 Forest Service 25.9 State 18.5
Inadequate fire protection	21	County 38.1 Forest Service 33.3
Decline in water quality	19	Self and Neighbors 42.1 State 21.0
Inadequate water supply	15	Self and Neighbors 46.6
Inadequate sewage disposal systems	14	County 42.8 Self and Neighbors 31.4
Lack of, or poor utilities	13	Developer 30.7 Others 30.7
Uncontrolled subdivision	12	County 58.3 State 25.0
Crowding, neighbors too close	11	Developer 63.6 Neighbors 18.2
Undesirable neighbors	11	County 45.4 Others 36.3
Building permit difficulties	10	County 70.0 State 20.0

And in the words of one respondent, "I can't over-emphasize the need for the Forest Service to show the public where private lands are within public land...People who use (the) public land(s) should be kept within them. More restrictions on the use and abuse of public land would help us all."

Also of interest is the fact that the problems which landowners feel have become worse in recent years are roads, traffic, trespass and vandalism and deteriorating natural surroundings, in that order.

There is reason for optimism in believing that many of these problems can be dealt with effectively. The basic desires of most residents in the area are compatible in many respects with those of the Forest Service although there are, and probably will be, points of difference. Improved communications between the Forest Service and these landowners would be highly desirable, but much time and difficulty is likely to be involved in accomplishing this. Fortunately, a large percentage of the residents are local people with primary residences in the same county. Denver residents and others would be more difficult to reach.

The problem which the Forest Service faces in these situations is considerable. Before the properties under study were subdivided, it was a relatively simple matter for Forest Service personnel to maintain contact with the several owners of the properties. But the subdivision process has created 100+ small property owners where previously there were perhaps less than five at most. The communications problem has truly exploded and even though an opportunity may still exist to work out mutually satisfactory development plans, the Forest Service does not begin to have manpower adequate for the task if each landowner must be contacted.

Economic Implications of Second Home Developments in Selected Areas of Colorado[1]

Richard G. Walsh, Michael F. Retzlaff, and Eliot O. Waples[2]/

Abstract.--Costs and benefits of condominium ownership at three Colorado ski areas were estimated on the basis of a sample survey in 1974. Costs of owner use under recent inflationary conditions were $37 per day compared to rental rates of $32. Under stable investment values, owner costs would rise to $59 per day. If investment values fall 5 percent annually, costs would rise to $103 per day of owner use.

INTRODUCTION

Increased attention has been focused in recent years on the development of second home subdivisions, primarily large condominium complexes, near the base of ski areas in the Rocky Mountains. Until recently, most Western communities and state governments welcomed and encouraged the development as a source of new income and general economic growth. It is now becoming apparent that the costs resulting from these developments may exceed the benefits they provide. The people involved are interested in what can be learned from recent experience that will help formulate sound development policies for the future. What have been the objectives of condominium buyers? How has condominium ownership worked out in terms of economic costs and benefits? What are the expectations for the future?

This paper provides answers to some of the questions that have been raised. It reports on the findings of a survey of condominium owners in Breckenridge-Dillon, Steamboat Springs, and Vail, Colorado. A random sample of 410 condominium owners was drawn from subdivisions near the base of these three ski areas. Response rate was 24 percent to a mail survey in the spring of 1974. The 99 useable replies represent a 2-4 percent sample of the universe.

OBJECTIVES OF CONDOMINIUM BUYERS

In the past decade, a large market developed for condominiums in second home subdivisions of Colorado. One function of the market has been to provide overnight lodging services to buyers and their families engaged in outdoor recreation activities, notably skiing. Another function has been the opportunity provided for rest and relaxation in a scenic mountain setting. Fully two-thirds of the buyers sampled primarily sought one or the other of these two closely related objectives. Forty-two percent reported recreational activities, and 22 percent reported rest and relaxation.

Not as well known has been the economic function of the market for condominiums in these second home subdivisions. The primary objective of one-third of the condominium buyers in the past has been investment return. This was most evident in Steamboat Springs where nearly one-half (47 percent) reported that the primary reason for purchasing a condominium was investment return. Typically, these buyers expected their second home investment to provide rental income and a capital gains tax advantage, and only secondarily recreational lodging for themselves. In addition, nearly half (46 percent) of condominium buyers reported that investment return was the second or third ranking reason for purchase. This was particularly true for Vail where nearly 55 percent of condominium buyers reported that investment return was the second or third ranking reason for purchase.

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[1]/Paper presented at a symposium, Man, Leisure and Wildlands: A Complex Interaction, U.S. Forest Service, Vail, Colorado, September 17, 1975.

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Table 1. Reasons for purchasing a condominium in Breckenridge-Dillon, Steamboat Springs, and Vail, Colorado, 1974

Rank order of reasons for purchase	Area			
	Breckenridge-Dillon	Steamboat Springs	Vail	Areas Combined
	Percent	Percent	Percent	Percent
As an Investment				
First	30.6	47.4	32.3	34.3
Second	14.3	15.8	29.0	19.2
Third[1]/	32.7	15.8	25.8	27.3
Total	77.6	79.0	87.1	80.8
As a Headquarters for Recreation Activities (Skiing)				
First	30.6	47.4	58.1	42.4
Second	32.7	15.8	16.1	24.2
Third	22.4	15.8	3.2	15.2
Total	85.7	79.0	77.4	81.8
As a Place for Rest and Relaxation				
First	36.7	5.3	6.5	22.2
Second	30.6	52.6	25.8	33.3
Third	16.3	10.5	19.3	16.2
Total	83.6	68.4	51.6	71.7
Other Reasons[2]/				
First	2.0	-	3.2	2.0
Second	8.0	-	0	4.0
Third	10.1	-	9.7	8.1
Total	20.1	-	12.9	14.1

[1]/To simplify the table, an infrequently reported fourth ranking was included in the third rank category. This included five reasons in the case of the Breckenridge-Dillon sample, and two reasons in the case of the Vail sample.

[2]/Other reasons for purchase included: (1) as a subsequent retirement home, and (2) for the entertainment of guests such as relatives and business associates.

How well has the condominium market fulfilled the economic function? Nearly one-half (48.5) of the buyers reported that owning a condominium failed to meet expectations as to investment returns. Either the quality of condominium association management was low and expenses were excessive (28.3 percent) or rental income was lower than expected (20.2 percent). This was particularly evident in Steamboat Springs where over two-thirds (68.4 percent) reported their expectations with respect to investment returns had not been realized. Problems of management quality and turnover, rental income, and property damage were reported by nearly two-thirds (63 percent) of condominium buyers. Such problems were most frequently reported by Steamboat Springs buyers, and least frequently by Vail buyers.

Other buyers reported no problems with the management and rental of their condominiums (36.4 percent). Investment return met or exceeded the expectations of 27.2 percent of all condominium buyers reporting. This was slightly higher for those in Vail (32.2 percent). Expectations with respect to recreational activities were met or exceeded more frequently in Steamboat Springs and Vail than Breckenridge-Dillon by a two-to-one margin. Expectations as to rest and relaxation were met or exceeded in Breckenridge-Dillon by a margin of about ten-to-one over Vail and more than five-to-one over Steamboat Springs.

The result is that use patterns change after the first year of ownership and many owners put their condominiums up for sale. The number of days owners use their condominiums has declined by 13 percent in Vail and 7 percent in Steamboat Springs compared to their use during the first year of ownership. Breckenridge-Dillon owners increased the number of days they spend at their condominium by 15 percent over the first year of ownership. Annual turnover of condominium

ownership was rather high: 44 percent in Steamboat Springs, 33 percent in Breckenridge-Dillon and 23 percent in Vail.

COSTS AND BENEFITS OF CONDOMINIUM OWNERSHIP

The investment value of condominiums averaged about $40,000 in the spring, 1974. The range was from $15,000 to $75,000. Those located in Vail were substantially higher in value, while those in Breckenridge-Dillon were lower. Investment in furniture and equipment averaged $3,100 when purchased separately. This is shown in Table 2.

Table 2. Total investment and average annual costs and benefits of condominium ownership and use, Breckenridge-Dillon, Steamboat Springs, and Vail, Colorado, 1972-1973

Costs and Benefits	Breckenridge-Dillon		Steamboat Springs		Vail		Areas Combined	
	Annual	Per Day[2/]	Annual	Per Day	Annual	Per Day	Annual	Per Day
Investment Costs	$34,804.25		$39,556.25		$49,202.88		$39,962.50	
Condominium	32,900.00		38,400.00		42,900.00		37,300.00	
Furniture & Appliances	2,650.00		2,150.00		4,550.00		3,105.00	
Annual Costs	7,438.20	$175.85	9,104.66	$321.71	10,423.23	$299.82	8,931.14	$251.37
Operating Costs[1/]	1,863.62	44.06	1,463.23	51.70	1,455.59	38.20	1,670.03	43.27
Property Taxes	366.94	8.67	518.89	18.34	533.33	14.00	441.20	11.43
Insurance	107.35	2.54	137.14	4.85	132.96	3.49	119.90	3.11
Electricity	165.92	3.92	220.63	7.80	208.85	5.48	187.80	4.87
Telephone	85.88	2.03	125.71	4.44	113.16	2.97	100.68	2.61
Repairs	466.94	11.04	548.42	19.38	711.00	18.66	551.00	14.27
Rental Management & Association Dues	697.29	16.48	721.60	25.50	1,623.00	42.60	966.05	25.03
Recreation Equipment	414.54	9.80	275.56	9.74	492.96	12.94	412.51	10.69
Recreation Use Fees	190.89	4.51	340.00	12.01	462.22	12.13	294.63	7.63
Opportunity Cost	2,784.34	65.83	3,164.50	111.81	3,936.23	103.31	3,197.51	82.83
Depreciation	1,571.28	37.15	1,693.44	59.84	1,921.07	50.42	1,697.93	43.99
Travel Expenses	391.06	9.24	972.38	34.36	1,480.19	38.85	821.14	21.27
Travel Time Cost	1,324.74	31.32	2,478.38	87.58	2,973.26	78.04	2,024.39	52.44
Food	500.41	11.83	408.65	14.44	524.64	13.77	492.54	12.76
Annual Benefits	1,949.96	46.10	3,794.31	134.07	5,790.74	151.99	3,430.08	108.86
Rental Income	1,029.79	24.34	1,562.50	55.21	3,259.26	85.54	1,793.33	46.46
Appreciation[3/]	422.06	9.98	1,466.31	51.81	1,233.22	32.37	851.06	22.05
Tax Savings	498.11	11.78	765.50	27.05	1,298.26	34.08	785.69	20.35
Net Annual Costs	5,488.24	129.75	5,310.35	187.64	5,632.49	147.83	5,501.06	142.51

1/Annual operating cost items do not equal total operating costs shown because averages are for those reporting and do not include nonrespondents, and (2) depreciation is not included in the total.

2/Per day of owner use in 1973. See note 1/ to Table 3.

3/Adjusted for inflation averaging 6 percent and for capital gains taxes estimated as 1.8 percent.

Operating costs are the out-of-pocket costs associated with owning a condominium. Largest by far were rental management fees and association dues averaging $966. The range was from zero to $4,630. These costs varied with the number of days rented and the nature of rental commission. It was customary for those reporting to include maid service, sewer, water, and garbage collection fees in this category. In addition, heating costs were often included here when central natural gas or oil systems were used rather than electricity. Some also included repairs.

Electricity at $188 per year often included heating by this means. The range was from $40 to $575. A surprisingly number of condominiums lacked telephone service (42 percent). Payment for this service averaged $100 annually.

Property taxes at $441 averaged about 1.2 percent of market value excluding furniture and equipment. The range was from $163 to $1,000.

Costs of fire, hazard and theft insurance averaged slightly over 0.3 percent of market value of the property insured.

Repairs at $551 averaged about 1.5 percent of investment at current market value. The range was from zero to $2,026. Included were repairs to the building exterior and interior, roads and driveways, water and sewage systems, and replacement of expendible linens and kitchen utensils.

Depreciation was estimated to average $1,698 for the first year. Normally, depreciation is calculated using the double declining balance method over a 40-year, useful life of structures, with zero salvage value. This is equivalent to 5 percent on the undepreciated balance of investment, excluding land. However, land was not valued separately by respondents and therefore it was included in the calculation. Furniture was depreciated similarly over a 10-year, useful life.

Opportunity cost and interest on investment averaging $3,197 were estimated as 8 percent of the total investment in the condominium including furnishings and equipment. This estimate was based on two considerations. The average interest rate was 9 percent on second home mortgage loans made by Colorado Banks in the summer of 1973, and less in earlier years. The potential return to owners' equity was 7.8 percent on corporate bonds in 1973. Most owners also made payments on the principal of mortgage loans, but this was considered an investment and was excluded from costs.

Recreation use fees averaged $295 which included ski lift tickets and payments for access, boat launching, horseback riding, and the like. Recreation equipment expenditures averaged $412 for clothing and skis, boots, fishing tackle most of which have a short useful life of one to two years.

Travel costs were broken into two components: time cost and travel expenses. Travel expenses averaged $821 and included 10 visits annually averaging 1,100 miles round trip per visit. Travel by Vail owners averaged 7-8 trips of 1,812 miles each compared with Breckenridge-Dillon owners who took 13 trips averaging 638 miles annually. Table 2 shows that expenses reflect these differences in distance traveled. Travel costs per person averaged 4.8 cents per mile, which is close to the estimate of Burt and Brewer (1971) and Walsh (1974).

Time cost was defined as the opportunity cost of time while traveling, valued at the recreationist's wage rate. Travel time costs were $2,024 annually at 14.4 hours per trip and annual household income $56,400 or $28.20 per hour.

Food costs only include expenditures over and above normal food expenses at home. These costs were calculated as $12.76 per day, based on recent food studies (Bureau of Labor Statistics 1975).

Economic benefits to owners of vacation home condominiums included rental income, appreciation in value of the investment, and tax savings. Rental income was the largest benefit of condominium ownership, averaging about $1,800 per year for 80 days rental. Rental income in Vail was substantially higher, while those in Breckenridge-Dillon were lower, reflecting the number of days rented. Average number of days rented in Vail was 133 compared to 60 in Breckenridge-Dillon. Nearly all of the condominium owners (84 percent) offered their units for rent about 90 percent of the year.

Income tax saving to owners of vacation home condominiums was estimated as $786 per year. Tax savings were substantially higher in Vail, and lower in Breckenridge-Dillon. These savings would be offset somewhat by increased operating costs of renter use. Property taxes and mortgage interest may be deducted from ordinary income in full. If rental income is greater than these two costs, a portion of operating expenses and depreciation may be deducted up to the total amount of rental income, according to an Internal Revenue Service ruling July 12, 1972, on tax savings from condominiums designated as vacation homes. The sum of deductions cannot exceed rental income unless the condominium is used exclusively for rental purposes.

Appreciation in the value of investment in condominiums has averaged 11 percent annually in the study areas. This unadjusted appreciation rate averaged 12 percent in Steamboat Springs and Vail, compared to 9 percent in Breckenridge-Dillon. The $851 appreciation shown in Table 2 has been adjusted for erosion in the dollar values to January, 1974, and for capital gains taxes. The adjusted appreciation rate was roughly 3.2 percent.

EXPECTATIONS FOR THE FUTURE

There are essentially three possible future conditions that may affect the economic costs and benefits of condominium buyers in Colorado: (1) the recent inflationary trend in investment values may continue, (2) prices may stabilize eliminating benefits from the 3.2 percent average annual appreciation in investment values, or (3) prices may enter a depressed trend in

which investment values fall by some amount, illustrated here by adding a 5 percent annual decline in investment values. Table 3 shows the effects of these three possible scenarios on average annual costs and benefits.

costs to buyers of condominiums would rise sharply. Their costs would increase by nearly one-half (46.3 percent) to $208.50 per day of use, as compared to costs in 1973. Total annual costs would rise from $5,500

Table 3. Average annual costs of condominium ownership under recent increases in investment prices and alternative steady and falling investment price trends, Breckenridge-Dillon, Steamboat Springs, and Vail, Colorado[1/]

Costs Under Alternative Price Trends	Breckenridge-Dillon	Steamboat Springs	Vail	Areas Combined
Average Total Costs Per Year				
Inflationary Prices	$5,488.25	$5,310.35	$5,632.49	$5,501.06
Steady Prices	5,910.31	6,776.66	6,865.71	6,352.15
Depressed Prices	7,481.59	8,470.10	8,786.78	8,050.08
Average Total Costs Per Day				
Inflationary Prices	129.75	187.64	147.83	142.51
Steady Prices	139.72	239.45	180.20	164.56
Depressed Prices	176.87	299.30	230.62	208.55
Average Lodging Costs Per Day[2/]				
Inflationary Prices	63.62	29.45	(-10.47)	37.23
Steady Prices	73.76	81.26	21.90	59.29
Depressed Prices	110.90	141.10	72.32	103.28

[1/]Annual occupancy was slightly higher for respondents included here who gave complete cost information than for the entire sample of 99.
Breckenridge-Dillon: 42.3 days of owner use, 60.7 days of renter use;
Steamboat Springs: 28.3 days of owner use, 46.4 days of renter use;
Vail: 38.1 days of owner use, 133.4 days of renter use; and
Areas Combined: 38.6 days of owner use, 79.9 days of renter use.
[2/]To calculate average cost per user day, divide through by average household size of 3.0 in Breckenridge-Dillon, 3.4 in Steamboat Springs, 3.7 in Vail, and 3.3 overall.

Costs to buyers of condominiums were $5,500 annually or $142.50 per day of use in 1973. This would increase by 15.5 percent if future prices were to stabilize eliminating benefits from annual appreciation in investment values. It was assumed that all other costs and benefits remained at 1973 levels. Steamboat Springs and Vail owners would be more severely effected because they have enjoyed relatively higher appreciation rates in the past. Breckenridge-Dillon costs per day of use would increase by about 28 percent and Vail costs by 22 percent daily. Breckenridge-Dillon owners would suffer only nominal cost increases of 8 percent per day because of lower appreciation rates in the past.

If the economy became depressed and the market price of condominiums fell 5 percent annually, other conditions remaining the same, under current inflationary conditions to $8,050. Steamboat Springs and Vail owners would be more severely effected because their investment values were relatively higher than for Breckenridge-Dillon owners. Costs of daily use would increase 36 percent in Breckenridge-Dillon compared with 60 percent in Steamboat Springs and 56 percent in Vail.

It is meaningful to compare the cost of lodging incurred by condominium owners under (1) recent inflationary conditions to cost of lodging under (2) conditions of steady investment price trends and (3) depressed prices. Lodging costs included all costs shown on Table 2 except transportation, travel time, recreation equipment and fees, and food. The resulting average cost per day for lodging is shown at the bottom of Table 3.

A 1974 study of expenditures by Aspen skiers showed average lodging costs of $50 per day (Goeldner 1974). Nearly 40 percent of the skiers interviewed rented a condominium, compared to 44 percent who rented a lodge, motel, or hotel. Average daily rental rates for the condominiums surveyed were $40.50 in the winter ski season and $23.40 in the summer season. Vail had the highest average winter rates with $51.00 and Breckenridge-Dillon the lowest with $30 per day. Steamboat Springs winter rates were $50. Vail had the lowest summer season rates with $21.50 per day compared to $24 in Steamboat Springs and Breckenridge-Dillon where opportunities for summer recreation may be somewhat greater. The lower summer rates in Vail may also reflect the fact that they were more successful in obtaining renters who occupied the units for longer periods of time. Forty-four percent of Vail rentals were for 180 days or more, while this was the case for only 23 percent of Breckenridge-Dillon and 13 percent of Steamboat Springs rentals.

Under recent inflationary conditions, average costs of lodging to the condominium owners surveyed were $37.20, about $5.00 per day more than the average rental rates charged for the same condominiums of $32.17. This weights winter and summer rates by owner use in the two seasons. Lodging costs of owners in Breckenridge-Dillon at $63.60 per day were more than double the rental alternative, with costs $36.80 more than average rental rates of $26.80 for the same units. The situation in Vail was in sharp contrast to this. Vail owners have had free use of their condominiums in the past. In 1973, their condominium benefits contributed $10.50 per day of use toward other recreation and travel expenses. In Steamboat Springs, lodging costs to condominium owners were $11 per day less than the weighted rental rates of $40.50 for the same units.

If future prices were to stabilize eliminating benefits from annual appreciation in investment values, costs of lodging to condominium owners would rise to $59.30 per day, or $27 more than weighted rental rates for the same units. Vail owners would still incur costs about half those of renting but costs of Breckenridge-Dillon and Steamboat Springs owners would be more than twice those of renting.

If the economy became depressed and the market price of condominium fell 5 percent annually,[3] lodging costs to owners would rise to $103.30 per day, or $71 more than weighted rental rates. Under these conditions, Vail owners would incur costs $32 per day greater than rental rates for the same lodging. Breckenridge owners would pay $84 per day more than the renting alternative. Steamboat Springs owners would pay more than $100 per day over rental.

IMPLICATIONS FOR PUBLIC POLICY

Inflation in the Cost of Skiing

The average total cost of skiing has been increasing faster than the rise in the consumer price index since 1968. Skiing costs including lodging have risen at a rate nearly 50 percent greater than the index of all consumer purchases. The consumer price index rose by about 55 percent from 1968 to 1974 compared to the costs of skiing at Aspen which climbed 81 percent over the same period of time (Farwell 1974). Most (92.5 percent) of the Aspen skiers were out-of-state so this comparison does not apply to Colorado resident skiers.

At a 1974 cost of $205 per day for a family of 3, skiing in Colorado is becoming less and less accessible to the out-of-state middle class. Condominium ownership reduced this cost somewhat. The lodging portion of the average costs per day for Aspen skiing families was $50. Condominium ownership in the three study areas reduced this to an average of $37 per day as shown in Table 3. It seems ironic that these savings tend to go to families whose ability to pay is much greater than for most skiers. Skier incomes tend to be above average U.S. household income. Yet, incomes of condominium buyers in Colorado ski areas were even higher than for skiers. Approximately one-half of Aspen skiers had incomes of $25,000 or greater, compared to nearly 90 percent of the condominium owners we sampled in the three study areas. The estimated average income of Aspen skiers was $40,500 compared to $56,400 for condominium owners. Fully 20 percent of the skiers had incomes below $15,000 compared to only two percent of the condominium owners studied.

Indications are that the rise in the market price of condominiums has exceeded recent increases in construction costs, thus contributing to inflationary pressures. The market value of condominiums in this study appreciated at an annual rate of 11 percent compared to the Department of Commerce composit construction cost index (with equivalent weighting) which increased at a rate of 9 percent. Over 10 years, a 2 percent annual increase in value adds 22 percent more to inflationary pressure, while a 3

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[3]/It was reported this summer that prices on vacation homes including condominiums were running 10 to 15 percent less than in 1974 (Business Week, 1975).

percent annual increase (Steamboat Springs and Vail) adds 34 percent.

Testimony was taken by the Colorado Land Use Commission that the development of Vail has had an inflationary effect on worker housing throughout the county (Hearings 1974). This would be subtracted as a cost in estimating the regional economic impact of Vail on the local economy.

Governmental Subsidies to Condominium Buyers

Condominium developments near the base of ski areas in Colorado have received subsidies from various units of government. Careful consideration should be given to whether these subsidies achieve socially beneficial results, and whether they should be continued in the future.

Local units of government in these areas provide a property tax subsidy estimated at approximately $520 per year. This is the difference between the average actual level of 1.2 vs 2.5 percent (Shelton 1968) for residential property elsewhere in the nation, on $40,000 market value. This affects the ability of local government to provide necessary services. Reassessment is underway in some areas.

The Federal and State income tax laws allow deductions of property taxes and mortgage interest, and a proportion of operating expenses and depreciation, up to total rental income. This subsidy was estimated as an average of $785.70 in the three study areas, and nearly $1,300 annually in Vail. There were some offsetting operating costs from rental use, not separable in this study. With a total of 4,145 condominiums in the three study areas, the U.S. Treasury provided about $3.3 million in 1972-1973 to help these rather high income investors buy their condominium properties. In Vail with 1,500 condominiums in 1972-1973, the subsidy was estimated as nearly $2.0 million. Congress may ponder whether to continue the deduction of property taxes and mortgage interest on a second home. In addition, a question may be raised whether any portion of operating costs and depreciation are reasonable deductions on second homes rented out only 80 days per year, the average reported in the three areas.

The Federal and State income tax laws also allow capital gains income to be taxed at 50 percent of the tax rate on ordinary income of individuals. This would have averaged at least $648 annually in the three areas, a minimum of $894 in Vail. This subsidy, like the others, is limited to individuals who can afford to invest in real estate, and discriminates against lower and middle income taxpayers whose ordinary income is primarily salary or wages.

The Federal and State income tax laws also allow deduction of the cost of travel for business purposes. This subsidy was estimated as $41 per household annually. It averaged $124 in Vail and $63 in Steamboat Springs. A substantial part of the travel by condominium owners in Steamboat Springs and Vail was for business purposes, a minor part of which was to attend condominium association meetings and inspection of property. Recently, IRS tightened up allowable travel deductions for condominium ownership meetings and property inspections. Overall, business purposes accounted for 28 percent or two trips by condominium owners to Vail, and 18.4 percent or one trip to Steamboat Springs, but only 9 percent or one trip to Breckenridge-Dillon where most Denver residents engage in year around recreation on weekends. In comparison, a sample of all Aspen skiers showed that business purposes accounted for only 12 percent of their trips (Goeldner 1974).

Existing Forest Service regulations with respect to development of ski areas provide a subsidy to owners and developers of private land at the base of ski lifts which are located primarily on public land in the West. Forest Service fees average 2-3 percent of gross receipts from ski lift tickets, ski school and equipment rental, based on the proportion of the lift on public land (Walsh 1972, Price 1965). This allows base area developers to capture a substantive external benefit from land development. The extent of this subsidy is not known. It would be the annualized difference in the value of land and improvements with and without the opportunity to ski on public land nearby, all other things equal. No information was collected in this survey on condominium development in mountain areas away from ski areas on public land. However, most Dillon condominiums were located a considerable distance (5-10 miles) from the Breckenridge Ski area, while most Steamboat Springs and Vail condominiums sampled were within walking distance of the ski slopes there. Comparing Dillon to the other areas provides a very rough estimate of the extent of this Forest Service subsidy to base area condominium development. The difference in the market value of condominiums annualized at 8 percent was $384 for Steamboat Springs and $1,152 for Vail, compared to Dillon. This cannot be considered more than a mere estimate because the proportion of sample condominiums located in Breckenridge and Dillon has not been determined, quality and size varies among areas, and although Dillon condominium owners cannot walk to a ski slope, they can drive to several in less than 20 minutes (Breckenridge, Keystone, Cooper Mountain, Arapahoe Basin, and Loveland).

Energy Conservation

Condominium owners and skiers who live out of state consumed considerably more energy in travel than those who live in Colorado. Future governmental policies to conserve energy may reduce less essential long distance travel. This could lead to fewer out-of-state skiers in Colorado, with more downhill and cross-country skiing closer to home.

Skiers and condominium owners commonly reside in either (1) Denver and drive to the slopes on the weekend, or (2) in the Midwest or East and fly in several times a year staying about a week each time. If each household spends 38 days per year at the ski area (Vail, for instance), the Denverite makes about 19 trips while the distant owner, if from Washington, D.C., may make five trips. With average household size at three, and plane occupancy rate at 50 percent, a travel energy consumption per skier-day can be computed: the Denver condominium owner will use 420,000 BTU's per skier-day. The Washington, D.C. owner consumes 4,447,000 BTU's per skier-day. Despite the fact that the owner living 1,800 miles from Vail only makes five trips per year, his energy use is more than 10 times greater than the Denver owner. The travel energy consumption of a condominium owner from Chicago, 1,100 miles away, is 6.5 times that of the Denver skier. The average condominium owner in the three study areas traveled 1,100 miles round trip, thus his travel energy consumption was 3.25 times that of the Denver skier.

Passenger Mode	Energy Intensiveness[1]/ at 100% Load	Average Load, 1970 (%)	Energy Intensiveness[1]/ at Average Load	Average Speed (mph)
Bus	740	46	1,600	45
Railroad	1,100	37	2,900	40
Automobile	1,600	48	3,400	~50
Air	4,100	49	8,400	400

[1]/BTU per passenger-mile. See Hirst (1973), Gimmer and Luszynski (1972) and Hirst and Moyers (1971).

Effects on Recreational Behavior

Public policy that encourages condominium development affects recreation behavior. Recreation patterns changed when buyers used condominiums part of the year as vacation quarters for themselves and their families, and offered them for rent the rest of the year.

Condominium owners reported that the number of trips they would take to the areas would be about 58 percent fewer without condominium ownership. Fifteen percent would not come at all. Vail owners would take 45 percent fewer trips there. Ownership did not appear to effect the number of days per trip. Typical out-of-state owners in Steamboat Springs and Vail stayed an average of 7-8 days per trip compared to all out-of-state skiers in Aspen who stayed 7 days.

Owners who rented out their condominiums tended to use them less frequently themselves than those who did not rent. When condominium owners rented out their units part time, personal use per year declined 30 percent in Breckenridge-Dillon, 25 percent in Steamboat Springs, and 14 percent in Vail compared to personal use reported by all owners in the sample.

Forest Service Policy Questions

The concern about the high cost of skiing in Colorado has led the U.S. Senate to schedule hearings next month on a proposed bill to provide full disclosure of the relevant economic data and to allow for more public input in rate making decisions by the U.S. Forest Service. This study suggests that the price of lift tickets is only a part of the problem of increased costs of skiing. Costs of condominium ownership and of rental by skiing families are also important.

The Forest Service should consider including profits from land development and rental revenues from lodging in the determination of lift ticket prices. For now these external benefits of Forest Service administered resources are captured by a few fortunate individuals. This inflates ski lift ticket prices artificially. The principle of equity suggests that part of appreciation in values of land and improvements should accrue to society to the extent its resources create these values.

The Forest Service has the responsibility to consider ways to protect the public interest in moderate costs of private land development

and construction of seasonal housing units in mountain subdivisions at the base of ski areas on Forest Service administered land.[4/] Priority should be given to developments offering medium-priced accommodations and services, to both skiers and employees. The Forest Service can influence the availability of low and medium priced accommodations (condominiums, lodges and apartment rentals) serving some ski slopes on Forest Service land. The agency has jurisdiction over the original ski slope developer who may own a substantial portion of the private land located at the base of the ski slope. However, when ownership of much of the base area land is in the hands of others, the Forest Service may have little or no influence on development decisions. The proposed Senate bill should remedy this deficiency. Meanwhile, other government agencies and private interests should cooperate with the Forest Service in planning low cost housing for skiers and employees and their families, and necessary public services. Local housing codes can require new construction of large condominium or lodge complexes to include quarters for employees and their families.

To the extent that increased summer rental of condominiums and lodges in ski areas occurs, it may result in losses of revenues to summer resorts located wholly on Forest Service administered land. The Forest Service has written into its regulations the obligation to consider the effect of its actions on existing concessioners.

In an era of resource scarcity and limited growth in the U.S. Economy, forms of outdoor recreation should be encouraged that do not require large flows of irreplaceable resources or produce severe environmental degradation (Meadows et al., 1972). Many forms of athletics should be encouraged for this reason. Downhill skiing does not appear to qualify under current investment and cost conditions in the three study areas. Skiing may rank among the highest users of irreplaceable resources compared to all outdoor recreation activities. If the industry is to prosper and grow in the next few decades, it will be necessary to seek ways to limit investment and minimize costs, while avoiding severe environmental degradation.

4/"Priority will be given to developments offering medium-priced accommodations and services. A National Forest concession is designed and developed to furnish services to those seeking forest recreation. The facilities themselves do not constitute the recreation attraction. Hence, they will be adequate to provide reasonable comfort and convenience, but with no elaboration which would be out of keeping with the forest environment. They will normally offer accommodations at moderate cost, and special justification will be required for a permit covering exclusively high-priced accommodations and services." Forest Service Manual, Section 2344.03. Amend. 31, December 1968.

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Environmental Costs and Socioeconomic Benefits of Leisure Home Developments[1]

Peter G. Montague[2]/

Abstract. -- Numerous environmental and socioeconomic impacts occur from leisure home developments. This study lists the chief impacts and recommends policies which local governments can adopt to minimize problems while maximizing benefits. Special recommendations include initiation of a natural resource inventory and adoption of environmental impact review to guide the development process.

Something like three million American families - five per cent (5%) of the total number of U. S. families - own leisure homes. Leisure homes are now being built at the rate of 100,000 to 150,000 each year. (Housing Data Bureau, 1973). People who are very gloomy about the current economic outlook have questioned whether the boom in second homes can continue.

However, the Commission on Population Growth and the American Future estimated that by the year 2000 average family income will rise from the current $12,000 to more than $21,000 (in constant dollars) and that per capita consumption expenditures will more than double. (Rockefeller, 1972). This will leave increased amounts of money available for purchase of leisure homes. Shorter working hours will give people more leisure time. So it seems homes will continue.

With Richard Ragatz and Carl Burlingame we have adopted the term "leisure" home as opposed to "vacation home" or "second home", because the term leisure home more accurately reflects the uses to which such homes are put. The leisure home is used by weekenders and seasonal vacationers, but it may also be used by partially retired people who spend just a day or two a week at their office, as well as by the fully-retired. (Ragatz and Burlingame, 1973). The President's Council on Environmental Quality (CEQ) studied the costs and benefits of leisure home developments during 1973. The CEQ study concluded that:

> ...leisure homes are over time converted into permanent residences and therefore should be viewed as a special form of early urbanization which generates the same types of economic, environmental and social impacts as other residential developments. Further, leisure home developments may create more serious environmental problems - for example, on mountainsides or in wetlands - than normal suburban subdivisions.
>
> In terms of their economic impact on the local government, the study finds that as long as they are used only for recreational [part-time] purposes, leisure homes generally generate tax revenues in excess of the costs of the public services required. However, as the developments become converted to permanent homes, these costs may exceed the tax payments, particularly if conversion results in a need for public investment to upgrade or replace roads, water supplies, and sewers.
>
> Private recreational developments may also create social problems resulting from the impacts of outsiders on the local culture and the way such developments interfere

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[1]/ Paper prepared for the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975. Prof. Montague was unable to attend.

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with the public's use of valuable recreational environments." (Council on Environmental Quality, 1974).

The problems associated with leisure home developments are various. Here is a listing of problems which have been identified by one writer or another:

1. Increased water demand in water-short areas.
2. Environmental problems from disposal of residuals--liquid, solid and gaseous.
3. Increased demand for public services, (e.g. extensive road system, education system).
4. Inadequate regulatory structure for subdivision development, leading to numerous kinds of consumer frauds.
5. Inflation of land prices with the result that (a) farmers are driven off the land; (b) young people have a harder time getting established and tend to drift away.
6. Effects on nearby lands:
   - -Litter
   - -Wildlife Harassment
   - -Fire control problems
   - -Crowding
   - -Esthetic damage
   - -Noise
   - -Trash
   - -Garbage
   - -Sewage
   - -Soil compaction
   - -Vegetation destruction
   - -Erosion
   - -Water siltation
   - -Vehicle emissions: carbon monoxide, nitrogen oxides, hydrocarbons, particulates
   - -Dust
   - -Rock Removal
   - -Picnic-fire smoke
7. Absentee ownership of local land with consequent erosion of the local economy from the vantagepoint of local people, and with consequent erosion of local self-government.

In Iron County, Utah, eighty-six per cent (86%) of the lots sold during the past decade for leisure use were sold to out-of-state owners (mainly people from California and Nevada). These are clustered near Brian Head Ski Resort - which is about 2000 acres of privately held land surrounded by Dixie National Forest. (Shaw, 1973).

A study of the New England ski town, Warren, Vermont elaborated on this problem of absentee ownership. The Warren ski area was created in 1958; a survey in 1972 showed that out-of-staters own eighty-four per cent (84%) of the leisure homes in Warren. Seventy per cent (70%) of the landowners in Warren are non-residents and fifty-seven per cent (57%) are out-of-staters. The study shows there is an increasing trend for land to be sold to out-of-staters.

The study also showed that forty-eight (48%) of the privately-owned land in Warren is now owned by corporations or by realtors.

The town of Warren has, in the words of the study, been "infiltrated and expropriated from the original residents for the enjoyment, profit and use of the expropriators. A ski area came to Warren in 1958 and since that time the town has been excised from the traditional fabric that once made it part of Vermont. Less than one-third of the people who lived in Warren before 1958 still live there. Of the jobs that have been created since 1958, fewer than fifteen per cent (15%) have been filled by pre-development residents of Warren," says the study by the Vermont Public Interest Research Group. (Hedger, 1972).

Real estate values in Warren have skyrocketed, making it difficult for young Warrenites to strike out on their own, especially in the traditional land-based activities of farming, logging and sawmilling, the study notes. A study in Utah confirms what happens to raw land prices when subdivision occurs. Prices multiply by a factor of ten or more. (Shaw, 1973).

Basically, there are two kinds of developers - those who are intending to stay with their projects and create communities and those who are planning to sell the land and leave. The problem of land sales fraud stems largely from this second kind of developer. The situation with land sales fraud in the semi-arid southwest has reached astonishing proportions. At the 1975 meeting of the National Association of Attorneys General (held in Albuquerque, New Mexico) Robert Blakey, Jr., Assistant Attorney General of Arizona and head of the Land Fraud Division of the AG's office in Arizona, described the land sales game as "a gigantic problem which needs immediate attention."

According to Mr. Blakey, one land development company in Arizona would take people to the site by car - mostly elderly women on fixed incomes - and once there, would grill them for

hours and tell them they could not be taken home until they bought a lot. "One woman," he said, "bought five lots before they took her back home.... Land frauds will never be totally eradicated but if sufficient pressure is brought to bear by the public, the wholesale rape of the consumer will be brought to a manageable level," Mr. Blakey said. (Martinez, 1975).

We face, then, an extremely complex social phenomenon. Each leisure home presents a new set of problems or exacerbates an old one. And the cumulative impact is impressive:

In 1973, there were 163 new suburbs planned for Colorado's front range. In May of that year a writer in EMPIRE, the Sunday Magazine of the Denver Post, suggested that in thirty years or less Colorado's mountain country will be so developed with condominiums and homes that there won't be any reason to go there anymore. EMPIRE quotes a source "close to the Colorado Land Use Commission," saying, "We worry about the cumulative effect of mountain subdivisions, things like air pollution, schools, forest fires, water pollution, transportation and commuting, road maintenance and snow removal. In many areas we're at the point where no matter how well planned a development might be, it may have to be rejected because of the cumulative pressures of all the developments."

The EMPIRE article ends saying, "It is clear that the day when one buys a place in the hills 'to get away from it all' is about gone. Prime land, with its hill-to-hill houses, closely resembles the urban setting one seeks to escape." (Nyberg, 1973).

We can recommend two basic policy tools for helping local governments assess the desirability of proposed leisure home developments. The first is a natural resource inventory of their local area.

The basic elements of a Natural Resource Inventory (Office of Environmental Services, nd) are:

A. Geology
   1. Bedrock type and characteristics (structural type and age)
   2. Depth to bedrock
   3. Unconsolidated materials
   4. Mineral resources (e.g. sand, gravel)
   5. Geologic cross-sections

B. Hydrology
   1. Underground water
      a) Aquifer outcrop: thickness, location, extent
      b) Direction and rate of groundwater movement
      c) Groundwater recharge and discharge areas
      (You need to know these, whether they fall within the boundaries of your project or not.)
      d) Well locations and yields
      e) Quality of groundwater
      f) Depth to groundwater
   2. Surface Water
      a) Surface water (including frequency, quantity and direction of flow)
      b) Low flow of streams (mean seven-day flow with recurrence interval of ten years)
      c) Flood plains, and marshes, swamps, bogs, peat, muck
      d) Depth to groundwater
      e) Surface water quality, limnology
      f) watershed and sub-watersheds (drainage units)
      g) liquid waste and disposal systems

C. Geography
   1. Physiographic region and/or subregion
   2. Elevation, slope, relief

D. Meteorology
   1. Air quality (stationary and moving sources of air pollution)
   2. Prevailing air currents (air shed parameters)
   3. Type, intensity, duration and total of precipitation, plus information on evaporation rates
   4. Topographic effects on wind
   5. Maximum-minimum range of temperatures (on a monthly basis)
   6. Areas where fog occurs (including the frequency)

E. Soils
   1. Soil types, texture, stoniness, depth
   2. Shrink-swell potential
   3. Frost heave potential
   4. Erodibility (K factor - potential soil loss in cubic feet per year)
   5. Percolation rates
   6. Depth to groundwater
   7. Surface runoff, permeability
   8. Fertility (ability to support vegetation)
   9. pH (acidity-alkalinity)
   10. Cation exchange capacity (nutrient absorption)

F. Vegetation
   1. Classification by broad areas
   2. Fire hazards, history of wildfires
   3. Pollution-affected types
   4. Vegetation of recreational and/or

historic value (unique or scarce)

G. Wildlife
   1. Nuisance or hazardous species habitat
   2. Rare and beneficial species habitat
   3. Spatial and seasonal abundance and distribution within habitat

H. Historic and cultural factors
   1. Existing land use
      a) open space
      b) pipelines
      c) railroads
      d) roads
      e) recreation
      f) urbanization (characterize or describe it)
      g) agriculture
      h) waste treatment and disposal facilities (liquid and solid waste)
      i) environmental nuisances
   2. Proposed land uses (master plans, zoning maps, etc.)
   3. Historic sites and areas
   4. Possible or existing archeological sites
   5. Scenic qualities

After a natural resource inventory is completed, it provides a data base for decision-makers. It also provides the basis for our second policy recommendation, which concerns the development process itself.

Discretionary review should lie at the heart of all development guidance. Discretionary review should replace the old concept of "anything goes, so long as it meets minimum standards". The best regulatory mechanism for discretionary review is environmental impact analysis. The great benefits of the process are: 1) its focus on proposed developments; 2) its consideration of feasible alternatives; 3) its replacement of the "minimum standards" concept with a concept of seeking among feasible alternatives to find the one which is best for the public interest.

States should enact legislation, modeled on NEPA, requiring environmental impact statements in connection with major state, local and private actions that significantly affect the environment.

A good environmental impact statement must include:

1. A detailed description of the proposed action.
2. A detailed description of the existing environment which will be impacted.
3. A discussion of direct and indirect (including distant and delayed) effects on the environment which may result from the proposed action.
4. Identification of unavoidable adverse environmental effects.
5. An assessment of every feasible alternative to the proposed action.
6. A description of cumulative and longterm effects of the proposed action on the earth's environment.
7. Identification of any irreversible commitment of resources that might result from the action. (Leopold, 1971)

Discretionary review focuses on the consequences of proposed development and on feasible alternatives to it. Conscious choice of the best available options, instead of mere satisfaction of minimum standards, is the most realistic way to achieve quality in development.

State and local governments should enact strict legislation protecting open spaces in potentially productive agricultural areas and in other critical environmental areas. Here, completion of a Natural Resource Inventory is essential. Areas of critical environmental concern include:

1. Areas with important cultural or natural characteristics that development would interfere with. These include: all wetlands; floodplains of rivers, lakes and streams; areas of unstable soil or high seismic activity; steep slopes and ridgetops; rare or valuable ecosystems; valuable forests and related land; and historic districts.
2. Areas required for future public recreation.
3. Areas that would serve as buffer zones between urbanizing areas and would have a strategic significance in controlling the pattern of future development.
4. Potentially production farmland, which might also perform the buffer zone function.

Vermont is an example of a state that has decided to closely restrict land developers. Vermont requires a permit for any development involving ten or more acres or ten or more lots. Vermont's land use law prohibits a district commission from granting a development permit unless it finds that the development:

1. Will not result in undue water or air pollution.
2. Does have sufficient water available for the reasonably foreseeable needs of the development.
3. Will not cause an unreasonable burden on any existing water supplies.

4. Will not cause unreasonable soil erosion or reduction in the capacity of the land to hold water so that a dangerous or unhealthy condition may result.
5. Will not cause highway congestion or unsafe conditions of use on highways existing or proposed.
6. Will not cause an unreasonable burden on the ability of a municipality to provide educational services.
7. Will not place an unreasonable burden on the ability of the local government to provide educational services.
8. Will not have an undue adverse affect on the scenic or natural beauty of an area, aesthetics, historic sites, or rare and irreplaceable natural areas.
9. Is in conformance with a duly adopted land use plan, development plan, or land capability plan [statewide plans required by Vermont law].
10. Is in conformance with any duly adopted local regional plan. (Reilly, 1973).

Some leisure home developments can bring desirable broadening of the tax base for a community. However, at some determinable time, varying from community to community, this type of development will begin to have an adverse effect on the provision of general governmental services.[1] Even when this point is reached and surpassed, however, leisure home development can still appear to have little effect on the tax rate as long as expensive capital improvements and increases in operating costs actually required by the new development are put off by local government. During the earliest years of development, leisure homes can have a beneficial effect on the tax rate if reductions in the school tax rate made possible by the leisure home development offset required increases in other tax charges. The point at which costs exceed benefits from the developments may be passed very quickly or may be avoided for some time by shrewd local governments.

To deal effectively with leisure home developments the local municipal (or county) government has to organize itself to serve a "service population" which includes permanent population and occupants of leisure homes. Seasonal (leisure) development will increase demand on local services by increasing the size of the service population. Leisure home developments may increase the demand for services even faster than the service population itself increases because (a) the leisure home population may be even more demanding than the resident population, as far as services go; and (b) as a community grows it needs more urban services than a small rural community does.

Unbalanced growth of residential units without corresponding commercial and industrial growth can be a detriment to having a well-rounded community and this may lead to development of a specialized type of bedroom seasonal community that can have adverse impacts year-round.

As Ragatz and Burlingame have pointed out, we are witnessing in this decade the burgeoning of a new life-style based on leisure. A life-style that was formerly only available to a handful of wealthy people is coming into the range of possibility for better than half of all American families, and the ramifications are going to be important. As Ragatz and Burlingame have also noted, historically Americans have had a deep aversion to leisure for its own sake. The life of leisure is viewed by many with a deep sense of guilt and even fear. So the phenomenon we are watching involves a deeply-rooted struggle among psychological forces.

Will leisure home communities develop a stable lifestyle? In March, 1974, the New York Times reported a Colorado Health Department contract study which linked high drug use to a five-county region in Colorado - the Vail, Aspen, Breckenridge and Steamboat Springs area - with an economy developed primarily around recreational and leisure living. The study, carried out by the Behavioral Research and Evaluation Corporation of Boulder, Colorado, concluded that per capita consumption of drugs was significantly higher in the leisure-based lifestyle region, compared to statewide per capita drug use. The researchers collected data on beer, wine, hard liquor, heroin, barbituates and amphetamines. (Anonymous, 1974).

Therefore, it is not entirely clear that leisure-based communities can be developed without incurring serious hidden costs involving the mental and social well being of the residents. A healthy community should have these characteristics (Greater Hartford Process, 1972):

Wholeness - the ability to meet an individual's diverse and changing needs throughout his or her life cycle, from

[1] Montague, Peter G., "At the Edge of Wilderness, Evaluating Environmental and Socioeconomic Costs and Benefits of Leisure Home Developments Near National Forests in the Semi-arid Southwestern U. S. A." (In typescript) Albuquerque, N. M.: School of Architecture and Planning, University of New Mexico, 1975.

childhood through old age.

Variety - varied facilities, services, and settings for different kinds of life styles.

Balance - a population of each community approximating that of the region in terms of age, race, and income: a mix of land uses insuring sufficient economic base to support required services: a mix of housing types adequate to house all who work in the community.

Identity - a spirit of community in which neighbors know each other, share interests, and together feel a sense of responsibility for the future of the community.

Participation - governmental mechanisms allowing for citizen participation in the decisions that will affect their lives.

Stability - a low rate of mobility because people have either a real or felt sense of ownership in the community.

Delight - a physical environment that is aesthetically satisfying, that informs, delights, stimulates and calms.

These are the qualities of a sound community, and as local authorities review proposals for new leisure-home developments, they need to ask themselves the hard question: As this community of leisure homes changes and becomes a permanent community of first-homes, will it meet these criteria? If the answer appears to be no, then perhaps the developer can be induced to change his plans, or even to drop them altogether.

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The Benefits of Vacation Home Developments to County Governments[1]

Gordon D. Lewis[2/]

Abstract.--Vacation home developments grow and change in ways similar to urban subdivisions. In the early stages, they have relatively high benefit-cost ratios in respect to their requirements for government services. These ratios decline over time, and without careful planning, they can be reversed. County officials and land developers must provide early guidance to insure these developments are not detrimental to county revenue-cost relationships in the long run.

INTRODUCTION

Concentrated second-home developments such as those in the large ski areas at Vail and Aspen in Colorado and Big Sky in Montana are, without doubt, beneficial to county tax revenue flows. For example, THK Associates (1974) reported that Snowmass, in the Aspen ski complex, contains 5 percent of the population and 18 percent of the assessed value in Pitkin County. It receives 18 percent of the county's expenditures but contributes 22 percent of the county's revenue. Revenue-expenditure relationships are fairly similar for all the major ski areas, so I will limit my discussion to the more dispersed vacation home developments where relationships between county costs and revenues differ at any point in time and over various periods of time.

The establishment and expansion of dispersed vacation home developments appear very attractive to officials in predominantly rural counties. Such developments seem to offer an opportunity to enlarge the county tax base and improve tax revenues without changing existing tax rates or unduly increasing county expenditures. Moreover, such developments may increase employment opportunities and enhance other local economic activities. Local officials tend to base the granting of the authorizations and permits needed for vacation home developments on the following justifications:

1. Vacation home developments represent a higher use of the land than the agricultural pursuits presently being followed on these lands. This higher use increases the value of the lands so that land tax yields are automatically increased without necessitating any change in existing tax rates. Revenues are increased without legal action, and reevaluation costs are minimum as recent sale prices can be used to reflect market value.

2. Vacation home developments normally do not require increases in high-cost public services. Most county governments spend the greater part of their incomes in providing educational facilities and social services. These are high-cost items in the budget, and the addition of more students to the school system or a greater demand for social services such as medical care greatly increase the costs. The occupants of truly vacation home developments are transient to the area so they do not add children to the school system, and their needs for social services are supplied at their permanent residences.

3. Vacation home development, like all other residential developments, require private as well as public goods and services. Foods and fuels must be purchased, structures and equipment must be repaired, and recreational focal points must be

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1/ Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado. Sept. 14-19, 1975.

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serviced. The demands for these goods and services create activities in which cash flows are created or enhanced and additional employment is needed. The local economic activities are intensified and economic benefits are increased.

It is the purpose of this paper to examine these justifications to determine under what conditions they are valid, to what extent the expected benefits are actually produced, and how they are affected by changing characteristics of the developments over time.

LAND VALUES

The conversion of agricultural land to vacation home developments does increase land values for tax purposes. In fact, a series of value increases may occur. Richey (1972) in his study of a large vacation home development in Sauk County, Wisconsin, found that land values increased 30-fold over a 3-year period while passing through four stages. Value increases occurred when:

1. The original owner sold the land to the developer and the development plans were certified by a government agency.

2. The developer improved the site by constructing roads, surveying and staking lots, and clearing brush and undesirable vegetation.

3. The individual user purchased the lot from the developer and recorded the transfer of title with the county officials.

4. The individual user put in improvements such as water and utility systems, or erected a dwelling or other structures.

Richey also found that the value of nearby lands that were not part of the development and had not been recently sold increased only 8 percent over the same period. Apparently, Sauk County officials did not feel that the value of these adjacent lands increased simply because they had subdivision potential. Rather, the land was revalued only after the use actually changed. However, when the use changed, the county officials rapidly revalued the land using county land sales records and building permit issuance.

In the Southwest, the same pattern has occurred, but the question of "true" land values has arisen. Bleck (1972) found that there was little or no correlation between prices for subdivision lots and such factors as lot size, transportation systems and amenities such as electricity, telephone, water, gas, and fire protection. In fact, one developer requested that the tax value of his lots be reduced as 40 percent of the developer's sale price was promotion costs. Such overvaluation was reflected in resale prices. In Arizona, buyers found that vacation home subdivision lots were not good investments. Resale prices received ranged from 58 to 88 percent of the price originally paid by the developer.

In all cases, however, vacation home developments increase the value of the developed land over that for the land under the previous use, but the new value is not accurately reflected by the prices first paid for the lots.

COUNTY COSTS

In the initial stages of development and sale of lots in vacation home subdivisions, county costs are related primarily to the great amounts of time spent by local government officials--such as the county assessors, the assessment appeals boards, and the county treasurer--in establishing and adjusting taxable values and tax collection procedures. In later stages, as more lots are bought by individuals, the additional costs attributable to the subdivisions are primarily related to providing more county services such as the costs of police and fire protection, road maintenance, and trash disposal.

Adams et al. (1973) found that, in northern California, vacation home developments caused county costs to increase beyond the level of additions to county revenue. Their data indicated that Butte County would lose $160.82 per year per vacation home unit if a proposed 100-lot vacation home subdivision was developed. However, their study was based on the lot buyers being people who owned a primary residence elsewhere in Butte County, so Adams included some additional costs for operation of the school system. Moreover, Adams and his coworkers assumed that lot owners would spend over 16 weeks per year on the site.

These assumptions may be applicable to Butte County, but they do not indicate conditions typical of other areas. In fact, Hanson (1972) determined that over half of the buyers of lots in remote recreational subdivisions in northeastern California did not expect to use their lots in the near future, and that one-third did not expect to visit their lots at all. Moreover, Johnson (1973) found in his study of Ludlow, Vermont that, in the short run, vacation home developments have no adverse effect on school costs. Rather, they substantially increase the tax base without increasing the number of pupils attending school.

Thus, it would appear that vacation home developments should have no major adverse impact on county operational costs at the onset; purchases are made for investment and retirement purposes, and recreational use is for short periods of time (Johnson 1973).

ECONOMIC ACTIVITY

The owners of vacation homes patronize local stores and businesses and have an impact on the local economy. The extent and magnitude of this impact is dependent, of course, on the size, location, and type of development and the reasons for ownership. It can be quite variable in different areas of the Nation.

For example, Brown (1970) indicated that a 1,300 acre, 1,600 lot second home development in Pennsylvania doubled the economic activity in the area (an economic multiplier of 2). He estimated that the first $7 million invested in development would generate over $14 million in economic activity would accrue to local business firms.

Along the same lines, Robert R. Nathan Associates (1966) estimated that economic multipliers for counties in the Appalachian region ranged from 1.47 to 2.53. However, they indicated that, in most of the smaller communities, little of the expenditures would accrue to local business firms. The Appalachia study also indicated that many of the economic benefits of vacation home developments were offset because of seasonal aspects. Vacation home usage was usually related to some specific form of recreation which, in turn, was controlled by the season of the year or by the time period available. This usually resulted in periods of high economic activity followed by periods of little or no economic activity.

There is a feeling, however, that the adverse impacts are outweighed by the benefits, and steps should be taken to reduce the less desirable aspects. For example, Ferguson, Morris, and Associates (1971) point out that, in predominantly rural counties in the Southwest, agriculture will not provide a basis for economic growth, and manufacturing and mineral exploitation are dependent upon a number of physical and economic factors not available in many areas. They feel that, in many cases, the greatest potential for economic growth lies in developing tourism and recreation; they recommend developing summer and retirement homesites, as well as tourist and recreation services, to improve local economic conditions.

AN EXAMPLE

Gila County, located in central Arizona, is an excellent example of the effects of dispersed vacation home developments on rural communities. Most of the economic activity--ranching and mining--is concentrated in the southern part of the country around the population centers of Globe, Miami, Hayden, and Winkleman. The northern part lies along the Mogollon Rim in the forested transition zone between the high Colorado Plateau and the lower hill country; it contains but a few small, unincorporated communities. Roosevelt Lake lies between the two areas.

The resident population of Gila County increased from 25,745 in 1960 to 29,225 in 1970; an increase of 14 percent as compared to 36 percent for the State of Arizona (U.S. Bureau of the Census 1973). However, the assessed value of private lands and improvements in the county increased 93 percent in the 10 years between 1962 and 1972 (Table 1). This value growth is even more interesting when various school districts are compared. In the Miami and Globe school districts, where most of the county's population is concentrated, the assessed valuation increased 35 percent and 153 percent, respectively. In the northern part of the county, where populations are small and development is primarily recreation oriented, the assessed value increased 357 percent in the Pine school district and 422 percent in the Payson school district. Valuation in the Payson school district, which was less than half that of Globe in 1962, is now almost equal to that of Globe.

The major reason for this increase in assessed value seems to be the great number of vacation home developments. Thompson and Lewis

Table 1. Assessed valuation in all Gila County and in selected school districts in Gila County, Arizona, 1962 and 1972.

School Dists.	Assessed valuation 1962	1972	Increase in value
	Thousand dollars		Percent
So. Gila Co.			
Miami	24,997	33,646	35
Globe	4,087	10,351	153
No. Gila Co.			
Payson	1,815	9,468	422
Pine	522	2,387	357
All Gila Co.	47,033	90,645	93

(1973) found a total of 20,000 acres of privately owned land in the Forest Service's Mogollon Rim Planning Area. Almost 20 percent of this land had been dedicated to subdivision in 1972. At that time, there were 95 individual developments containing 10,314 lots around the communities of Pine, Payson, and Youngs (Table 2). Individuals had purchased 8,167 lots in these developments, but only about 16 percent had been purchased by people in the Mogollon Rim area (Table 3). Over two-thirds of the lots had been purchased by people from the Phoenix metropolitan area, and over 10 percent were owned by people whose primary residence was outside of Arizona.

This type of recreation development, with its absentee ownerships and increased property values, certainly has the potential for improving benefits to the county. The predominance of people from the Phoenix area within 100 miles insures a more or less year-round use. There is some seasonality, however: the greatest use comes in summer as the metropolitan population tries to escape the heat, but winter usage is quite high too.

The local economy benefits considerably. Data for Gila County are not available at present. However, if the information from the work by Adams et al. (1973) is adjusted for conditions in Gila County and for the lower lot ownership by county residents along the Mogollon Rim, some values can be estimated. Assuming a daily expenditure of $2.53 per visitor per day, family units of 4 people, and 17 weeks of annual usage of vacation homes, the 8,167 lot owners in northern Gila County can be expected to spend about $9.8 million per year. If a multiplier of 2 is assumed, total economic activity can be estimated at $19.7 million.

The county cost aspects are more difficult to quantify. Discussions with county officials indicate differing opinions as to the actual

Table 2.--Rural subdivisions in the Mogollon Rim area of Gila County, Arizona by location, size, number, and sales transacted, 1972.

Location by county and township[1/]	Total private land	Total land in subdivisions	Number of subdivisions	Total lots in subdivisions	Average size of lot	Proportion of lots sold
	Acres	Acres	Number	Number	Acres	Percent
12 - 8	1,025	1,004	23	2,864	0.35	66
12 - 9	1,358	227	3	440	.51	60
12 - 10	558	102	2	196	.53	[2/]100
12 - 11	160	32	1	63	.57	[2/]114
11½ - 10	239	231	3	832	.28	77
11½ - 12	228	24	1	89	.27	[2/]101
11 - 10	518	647	15	2,439	.27	88
11 - 11	343	50	3	161	.31	75
11 - 12	417	100	5	452	.23	92
11 - 13	255	18	2	145	.12	97
10½ - 14	226	199	4	410	.48	92
10 - 10	2,650	832	26	1,784	.47	94
10 - 11	170	85	2	235	.36	8
10 - 13	854	25	1	63	.39	100
9 - 13	638	196	1	44	4.45	9
9 - 14	6,639	136	3	97	1.40	44
	16,278	3,908	95	10,314	.38	79

[1/] Includes only those townships in which subdivisions were located in 1972.

[2/] Some of the original lots were divided into smaller lots by purchasers.

costs created specifically by vacation home developments, and the relationships of these costs to revenues generated. The major point of conflict between vacation home owners and the county government is over the level of road maintenance. The Gila County developments are, for the most part, widely dispersed so the miles of road per dwelling unit or lot is relatively high. Thus maintenance costs are also high. This is especially true as the lot owners seem to want a higher level of maintenance--smoother roads, better drainage, and more rapid snow removal--than was requested by the previous landowners. As a result, Gila County officials feel that road costs in northern Gila County are so high that the road taxes paid by vacation home residents do not cover the expenses. However, county regulations provide a formula distribution of all revenues, so taxes paid by vacation homeowners help support all county services. The lot owners in northern Gila County may receive a disproportionate share of road maintenance costs, but they also may pay a disproportionate part of the school district costs.

It is apparent that vacation home developments are creating benefits in the northern part of Gila County. They are improving the tax base by enhancing land values, and are increasing economic activity in the Mogollon Rim area. They are, at least, providing an alternative to the slow decay that was evident in the small communities of the area.

THE CONCEPT

In general, dispersed vacation home developments have been beneficial to local governments and local economics. The increased costs of new developments to local governments are covered by increased revenues, and the increases in economic activity can be handled by the existing commercial infrastructure and the present labor force. There are few severe strains placed on the existing institutions, and there is no increase in the need for county social and welfare systems. The establishment of vacation home developments can be justified by county officials as indicated earlier.

Table 3.--Lots purchased in subdivisions in Mogollon Rim area of Gila County, Arizona, by location of lot and primary residence of owners, 1972.

(Number of Lots)

Location by county and township[1/]	Total lots	Primary residence of purchaser					
		Phoenix	Rim area	Tucson	Other Arizona	California	Other United States
12 - 8	1,868	1,388	212	14	83	93	78
12 - 9	266	196	32	0	6	17	15
12 - 10	196	162	14	4	1	5	10
12 - 11	72	59	7	0	1	3	2
11½ - 10	641	513	20	2	32	51	23
11½ - 12	90	81	1	0	3	3	2
11 - 10	2,162	1,509	297	23	95	90	148
11 - 11	121	60	44	1	6	2	8
11 - 12	416	338	29	9	11	13	16
11 - 13	142	113	22	0	1	5	1
10½ - 14	374	312	10	2	19	10	21
10 - 10	1,690	768	617	3	85	73	144
10 - 11	19	15	4	0	0	0	0
10 - 13	63	51	6	0	1	2	3
9 - 13	4	4	0	0	0	0	0
9 - 14	43	22	1	0	4	0	16
TOTAL	8,167	5,591	1,316	58	348	367	487

[1/] Includes only those townships in which subdivisions were located in 1972.

As these vacation home developments mature and become established, there is good reason to believe that the basic conditions can change and the justifications may no longer be valid. It is highly possible that there is a life cycle in vacation home developments which, by leading to permanent residential subdivision status or to a decaying community, can create unplanned stress on local governments and nearby rural communities. These changes occur when:

1. Lot owners in a vacation home development become permanent, year-round residents or other than recreational visitors. In Arizona and New Mexico, there are examples of developments gradually making this conversion as lot owners retire and move into the development from their primary residences. This type of resident creates a greater demand for improved access and better medical facilities, and local governmental costs go up. Because most of the improvements were made before the lot owner retired and moved in, the land value does not increase so tax rates must be increased--a move that most land owners will resist strongly.

2. The improvements in the road system that are made when vacation home developments are created attract a number of families who move into the developments as permanent residents. These families are gainfully employed and commute to work, but they place a strain on local governments as they usually add to school enrollments and request social services not used by recreationists or retirees. School costs are the primary expenses of any local government, and are the major causes of deficits in county budgets (Adams et al. 1973). In fact, a typical lower priced residential development in Illinois created an annual deficit to the local government of $1,150 per dwelling unit (Stuart and Teska 1971).

3. The developments grow to such a size that recreational industries are attracted to the area. The region then begins to develop the urban attributes that are found around ski areas, mountain resorts, and ocean beaches, and the developments cease to be dispersed vacation home subdivisions. The problems faced by local governments change, and the organization of these governments often must change to meet them.

Thus dispersed recreation-oriented vacation home developments can change into solidly based urban or suburban developments that become a part of the local community. While the maturing, if you will, of these developments creates additional problems for local governments, it also brings assets to the area.

On the other hand, there have been developments in Arizona and elsewhere which have not created the desired benefits as they matured into definite communities. Many lots in these developments were purchased for investment purposes or for speculative gains; these lots were used very little, and almost no improvements, they may reduce the value of adjacent lots and the general esthetic appeal of the area (Tillson et al. 1972). Also, the absentee ownership may cause problems with tax delinquency or in forming development districts for sewer, water, and roads, which could slow further development and encourage decay.

Vacation home developments are beneficial in utilizing the recreation resource potential in predominantly rural area. They offer a means for increasing land values and expanding local economic activity. County tax revenues increase more rapidly than county costs, so local governments benefit. The benefits and the needs of these vacation home developments change over time, however, so planning by developers and by local government officials must be designed to direct and take advantage of the maturing of the developments as they move from transient seasonal use to permanent residential communities.

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Community and Regional Implications of Large-Scale Resort Developments: Big Sky of Montana[1]

David G. Stuart[2]/

Abstract. The MSU-NSF Gallatin Canyon Study[3]/ was a before and after study of the impacts of a large-scale recreational development upon a semi-primitive environment. Accepted research methodologies in some fourteen disciplines were used. It was found that careful site selection, planning, and application of best available technology could control many on-site impacts of the resort upon the bio-physical environment but that implementation of comprehensive land use planning and controls is required to minimize impacts of the resort and peripheral development upon the bio-physical and socio-economic (lifestyle) environment of the immediately surrounding region.

INTRODUCTION

The announcement in February, 1970 by Chet Huntley that a large-scale recreational resort was to be built in the West Fork of the Gallatin River produced a reaction of concern and speculation regarding potential impacts the development might have on the social, economic, and bio-physical environments of the area. The introduction of a development of such magnitude into a semi-primitive setting provided a unique research opportunity for such impacts to be assessed based on measurements before, during, and at the completion of the development. (Delays in the development schedule of Big Sky precluded at-completion measurements.) Early in the summer of 1970, a multi-disciplinary team of Montana State University scientists initiated a socio-economic-ecological study of the Gallatin Canyon area with supporting funds from the National Science Foundation IRRPOS and then RANN programs. The purpose of studying the "Impacts of a Large Recreational Development Upon a Semi-Primitive Environment" (project title) was to determine the degree of environmental compatability of the development and to establish guidelines for the planning of similar future developments.

Although this paper comes under the symposium heading of "Community and Regional Benefit" we have found that benefit is "in the eye of the beholder" and have chosen to present a very brief summary of project findings from the point of view of regional implications of resorts such as Big Sky of Montana, Inc. and leave the value judgements up to the reader.

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[1]/ Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

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Anne S. Williams, Assistant Professor of Rural Sociology, MSU, and John Reuss, Director of the Montana Environmental Quality Council provided valuable input into the preparation of this paper.

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Regional Clustering of Recreational Developments and National Parks[4]/

The community and regional implications of large-scale recreational developments are affected by the clustering of these developments along with National Parks and other large-scale recreational opportunities such as National Monuments and State Parks in the Rocky Mountain West. This clustering phenomenon becomes apparent in Figure 1. Were the map extended northward, a similar situation would be observed with regard to the Canadian National Parks. Therefore many of the considerations, such as transportation system needs, seasonal population and business fluctuations, associated with resorts such as Big Sky must be viewed in terms of their interactions with similar impacts of other recreation attractions in the area and the resulting cumulative impacts.

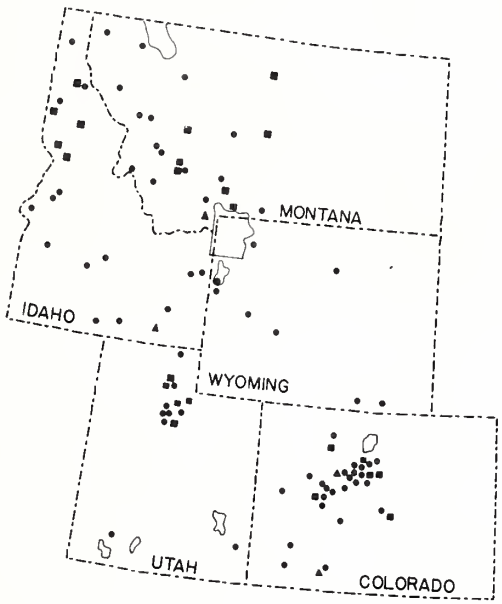

Figure 1.--Clustering of recreation attractions in the Rocky Mountain West. State boundaries (----), National Park boundaries (——), ski areas on U.S. Forest Service Lands (●), ski areas on private lands (■), proposed ski areas (▲).

Conceptual Framework of the Process of the Development of Big Sky

It soon became difficult, if not impossible, to grasp or visualize all the facets of the time. A systems analysis of the study produced a conceptual framework upon which problem areas, data, and interpretations could be organized. A much abbreviated representation of this conceptual framework is shown in Figure 2.

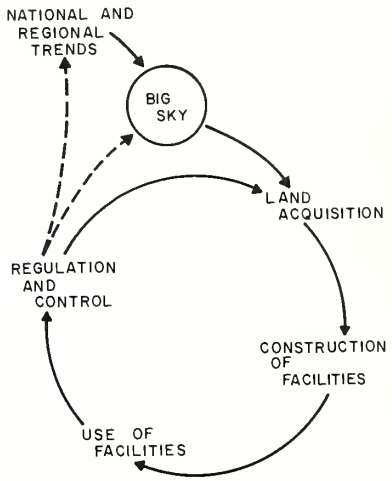

Figure 2.--A diagram depicting the interrelationships of the major components of the process of the Big Sky development.

The components of this cyclical representation of the system, or process, of the development of a resort such as Big Sky will be the focus of the rest of this paper.

SOME IMPACTS ASSOCIATED WITH THE DEVELOPMENT

Land Acquisition[5]/

Land grants to the railroads in the late 1800's resulted in a checkerboard pattern of private land ownership within what are now national park and national forest lands. The management difficulties imposed on both private and public owners by this situation led to Congressional action which allowed the Secretary of Agriculture to consolidate public lands by exchanging public for private lands. Although much of the Big Sky property was purchased from private owners, such land exchanges between the Forest Service and Burlington Northern Railroad made it possible for Big Sky to purchase land essential to the development. Two of these exchanges which had not been completed prior to

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4/ Concept and figure from unpublished manuscript of final report of the MSU-NSF Gallatin Canyon Study.

5/ A detailed discussion of the land acquisition decision-making process may be found in the forthcoming MSU-NSF Gallatin Canyon Study Monograph #17, "Analysis of Major Public Policy Decisions Affecting the Big Sky of Montana, Inc. Resort Development."

the announcement of the Big Sky resort development were the subjects of considerable public comment and were eventually contested in court.

The successful negotiation of the land exchanges left only small portions of ski runs to come under special use permits from the Forest Service thus removing the majority of development from Forest Service management.

The established policy and precedents for consolidation of these public and private lands have tremendous land use implications for the region due to the vast amount of similar land in the West and its potential for development.

Construction of Facilities

Construction of facilities on the Big Sky site has resulted in sizable economic impacts.[6] For example, some 60 million dollars have been expended to date resulting in the taxable value in the local school district increasing from $321,512 in 1970 to $1,555,866 in 1974. The result of this was that while the school district was deficit spending during the first few years of development (Stuart, et al., 1974), the 1974-75 revenues resulted in approximately $36,000 going from the school district to the state. Project findings indicate that tax revenue from the development over the long term will be in excess of total public expenditures for increased services.

Construction of the U.S. Highway 191 Spur road to the resort has also been a controversial issue and the subject of litigation due to the question of using public funds.[7] Delays in upgrading and paving the road have resulted in increased costs to both the developer and to the public, especially if public funds are used when the road is finally built. Undoubtedly, the active participation of the public in these decision-making processes concerning the land exchanges and spur road funding via the environmental impact statement requirements of the National Environmental Policy Act has had impacts upon the governmental decision-making processes involved.

Bio-physical impacts of construction have been minimal. There were periods of increased sediment during heavy construction resulting in complaints to state agencies. Data indicate some degradation of air quality during heavy construction periods also. No trends toward decreasing air or water quality have been observed to date, however. Little change has been seen in the wildlife of the Big Sky area. Logging had previously occurred on much of the Big Sky land and new construction activity was started before the land had regained its original habitat potential.

Use of Facilities

Although the Big Sky resort was not yet fully operational at the time that data gathering stopped, projections have been made on the basis of what has been observed. While project findings indicate that use of the resort by the planned number of people is not likely to lead to uncontrollable bio-physical problems on site changes are occurring as a result of the influx of people.

Recreation in the Canyon is destined to change considerably as a result of the use of facilities at Big Sky and peripheral development. Conflicts between different recreational land uses and between recreationists are probably more real than conflicts between the resort and the environment. For example, conflicts between big game hunters and residents have led to a request to ban hunting in the Canyon. If this request were honored, a myriad of environmental problems could result from overpopulation of big game animals. Forest Service campground use has been observed to follow Yellowstone National Park use with Big Sky having little effect. Big Sky has had little impact on fishing so far. Peripheral development where there is private land along the river shoreline will probably compromise blue-ribbon fishing stream criteria (access, aesthetics, use, and productivity) if not controlled. Much of the river shoreline is publicly owned along certain reaches of the stream and these should not be affected. Skiing has gone from virtually no skiing to 94,000 skier days in 1974-75 and an expected 765,000 skier days in 1991.

In order to transport that number of people, airport travel at Gallatin Field (Bozeman) is expected to go from 68,000 travelers in 1973 to 427,000 by 1985 with 56 percent of these travelers being Big Sky visitors. Facilities at Gallatin Field (jet port near Bozeman) are currently being expanded considerably in response to these increases in use. Historically, levels of traffic have been high in the Gallatin Canyon during the summer reflecting tourist use of Yellowstone National Park. The traffic impact of Big Sky has been mainly in the winter

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[6] More details of the economic impact may be found in the forthcoming final report on the MSU-NSF Gallatin Canyon Study.

[7] The details of this controversy may be found in the forthcoming NSU-NSF Gallatin Canyon Study Monograph #17. "Analysis of Major Public Policy Decisions Affecting the Big Sky of Montana, Inc. Resort Development."

having the effect of keeping traffic levels from dropping off during the winter. Long-term traffic increases on U.S. Highway 191 generated by increased development will require upgrading of the highway or development of a mass transportation system. Improved transportation will undoubtedly encourage secondary light industry that relies on effective transportation, which will in turn stimulate more development.

There have been changes in the rural character of the area as community development has taken place with the coming of Big Sky. The Canyon now has a good telephone system, a minister, fire protection equipment, a volunteer-fire-fighting force, and a larger school, with more classrooms and teachers. A logical consequence of community growth is the need for more electrical power which necessitates the building of larger powerlines across the area. Rather serious consideration has also been given to constructing a highway through Big Sky and over the mountain range to connect the Gallatin Canyon with the Madison River valley at Ennis.

Although development peripheral to Big Sky is proceeding rather rapidly in terms of planning and platting subdivisions, construction is progressing more slowly than some people expected which is leading to a complacency about the need for land use control in the Canyon.

Regulation and Control

There has been a history of unsuccessful attempts to establish land use planning in the Canyon. Even though 76 to 78 percent of the Canyon residents answering questionnaires indicated that they were in favor of land use planning, no plan has been accepted or implemented by the Canyon people.

Regulation and control of land use in the Canyon is largely in the hands of the Forest Service since 67 percent of the land in the Canyon is in public ownership. In the private sector, Burlington Northern owns 18 percent of the Canyon land and interacts with land uses on public lands. Counties are granted permissive power over subdivision activity but in the absence of a comprehensive plan guiding overall development such authority is rarely exercised. The only controls available at the state level are those requiring the Water Quality Bureau of the Department of Health and Environmental Sciences to certify the ability of the proposed subdivision to make available an adequate water supply, and to provide adequate sewage and solid waste disposal facilities prior to remvoing sanitary restrictions.

Interest groups have attempted to control or regulate development in the Canyon by court injunctions and other legal means made possible by the environmental impact statement requirements of national and state environmental policy acts.

GENERALIZATIONS THAT CAN BE MADE FROM THE BIG SKY EXPERIENCE

Local residents will oppose land use planning. Opposition to land use planning and its implementation by local residents arises from two basic causes. First, increasing land values and economic opportunities in areas peripheral to large-scale recreational developments make local landowners reluctant to have limits imposed with regard to what they can and cannot do with their land. Secondly, there is a strong commitment to private property rights and individualism that makes collective action difficult.

Environmental groups will interfere with the development of large-scale recreational and second home resorts at every procedural point. Their involvements have taken the form of legal maneuvers, which, although they function as a kind of "watchdog" of public interests over the actions of the private developer, they also cause numerous delays in the overall development schedules which in turn are extremely costly to the developer and often to the public. Developers are going to be more cautious and selective in siting and building large-scale resorts. The overall results of this will probably be fewer developments and more costly developments.

Public decision-makers are going to be more cautious. There appears to be a reluctance by the Forest Service and the B.N. Railroad to engage in further land exchanges, for example. These forces operate with the result that public decision-makers will go "strictly by the book" as much as possible. Under these conditions it is likely that highly sophisticated approaches using engineering problem-solving as a basis of approval will be relied on more and more. This again will increase the cost of developments.

COMMUNITY AND REGIONAL IMPLICATIONS OF LARGE-SCALE RESORT DEVELOPMENTS

Project findings indicate that the Big Sky Resort was located on the best site in the whole Canyon in order to minimize environmental impacts. Although it is not to be taken for granted nor treated lightly, and is expensive to achieve, it would appear from the work of

the MSU-NSF Gallatin Canyon Study that with adequate planning, careful site selection and application of the best available technology, large-scale recreation and second home resorts can be made to be compatible with the bio-physical environment of the region. If this be the case, the problem then becomes a socio-economic consideration of the most appropriate use of a limited and valuable natural resource. There is no longer an expanding frontier and it must be decided what is to be done with what we have of the Rocky Mountain West under the pressures of increasing population, leisure time, and affluence.

Based on the Gallatin Canyon experience, large-scale developments appear to bring prosperity to the area, and along with it, a profound change in lifestyle. What was once a semi-primitive natural setting with a rural society becomes a more urbanized area. In describing this phenomenon of large numbers of people coming to the mountains to recreate and to live, A.B. Guthrie, Jr. states: "They come to get away from it all and, in coming, bring it all with them."[8] There appears to be a growing consensus that the real issues being contested regarding resource use are not the disruption of basic ecological interrelationships which concerned Carson, Commoner, and Erlich, but are socio-economic parameters. This appears to be true regarding both the recreation-second home development in the mountains and the strip mining of coal on the plains of Montana. "Ecological factors are important but the most vociferous and emotional aspects of the opposition to resource development and use are concerned with threats to aesthetic values and lifestyles."[9] An indication of the current emphasis of the socio-economic component of public imput to decision-making through the environmental impact process is the recent Montana District Court decision in Montana Wilderness Association vs. Board of Health and Environmental Sciences holding that the Montana Department of Health and Environmental Sciences must re-impose sanitary restrictions on the Beaver Creek South subdivision in the Gallatin Canyon because the socio-economic portion of the environmental impact statement on the project was inadequate.

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[8] A.B. Guthrie, Jr. in the film "Voices of Land Use" produced by the Institute of Applied Research, Montana State University, Bozeman, MT.

[9] Roy E. Huffman in "Montana at High Noon: Conservation and Use of Montana's Energy Resources." Presented to the Montana Statewide Energy Education Conference, 1975. Fairmont Hot Springs, MT.

Traditionally, decisions to undertake large projects were carried out project by project on the basis of the benefit-cost ratio which generally neglected to adequately take into account such considerations as environmental impacts and lifestyles. There was also no effective mechanism for public input into the decision-making process. The benefit-cost ratio has been replaced by the environmental impact statement as required by section 102 of the National Environmental Policy Act and similar state laws. While this process emphasizes the environment and opens governmental decision-making up for public scrutiny and input, it is still a project by project approach which is leading to a changing of the rules once a project is started which is causing high costs to developers and the public alike. (The delays of the land exchanges and the blocking of the federal funding of the building the the U.S. Highway 191 Spur road are examples.)

In a region like the Rocky Mountain West with its peculiar land ownership problems, clustered large-scale recreational-real estate developments, National Park complexes, and large public ownership of land, a more efficient regional approach to natural resources use decision making is needed. This might take the form of regional land use planning which is already being worked with by such agencies as the National Forest Service and The National Park Service. Land use planning on public lands alone will not accomplish the task because of the interrelationships between large public facilities and large private developments.

Who makes the decisions as to whether or not a large-scale recreational-real estate development will be placed in a semi-primitive valley? The history of the Gallatin Canyon (Malone, 1973) shows that most land use decisions came from outside the Canyon. Consideration must be given as to who should make the decisions; how much weight should the desires of the regional resident have compared to the wishes of John Doe living in Chicago or New York City, and what mechanisms might be used to obtain and balance these inputs into the decision-making process.

Why the failure to formulate land use policy at any level? As described by Brittan and Brittan (1974) the roots of the problem are at least three-fold: technological, institutional, and philosophical-legal. First, even though many technical studies have been carried out, there is still much we do not know. Second, there is considerable institutional uncertainty as to who is to formulate and implement land use policy. There is much talk that local governments are responsible and should

do it amidst just as much talk that local governments are incapable of doing it. Third, and what I think is the real basis of the problem, "there are inherent conflicts in our concepts of private rights and public interest and in the values associated with them." (Brittan and Brittan, 1974) Our land ethic and associated laws are predicated on outmoded concepts, all of which need to be re-evaluated.

Given that the Rocky Mountain West offers a finite recreational resource, we must formulate and implement land use planning for the region, i.e., make the decisions and lay down the ground rules with appropriate public imput ahead of time so that the rules don't change after large developments are underway. More emphasis must be placed on the process by which the ultimate decisions are to be made rather than on the implications of decisions already made.

In the words of John Reuss, "Regional assessments of any kind of large-scale development need to begin with a picture of the limitations and the alternative resource uses of the existing natural and human environment... In the absence of good information, responsive institutions, and equitable regulations, the people who are to be affected by large-scale developments are going to be deprived of an opportunity to guide change."[10]/

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[10]/ John Reuss in the film "Voices of Land Use" produced by the Institute of Applied Research, Montana State University, Bozeman, MT.

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Colorado's Winter Resource Management Plan: The State's Responsibility for Comprehensive Planning[1]

James M. Ohi[2]/

Abstract. A review of Federal and State laws and regulations establishes the central role that the State must assume if we are to balance the competing needs of environmental protection, resource development and social-economic growth and attain a wide sharing of life's amenities. The State of Colorado is beginning to assume the central role by preparing a Winter Resource Management Plan.

According to our brochure, the sponsors of the Symposium have brought us together to discuss ways to minimize "the adverse impacts of leisure developments on wildland environments." The topic of the Symposium, Man, Leisure and Wildlands: A Complex Interaction, is an interesting one because it points out man's homeless status in nature's oikos, or house (from which the term ecology is derived). Man, as wise, intelligent primate mammal (Merriam-Webster), as featherless biped with broad, flat nails (Plato), or as the quintessence of dust (Hamlet) causes severe and often irreversible impacts on nature's house even in his leisure activities. However, the increasing availability of "leisure time" and the increasing visitation of wildlands by man may heighten our awareness of the complex and fragile interrelationship of the air, land, water, biotic and socio-economic resources upon which we impose our leisure. I think this symposium will have served its purpose if what we do here helps to remind us that our word, school, is derived from the Greek schole, which means leisure.

In Colorado, development of downhill skiing facilities has brought this interaction of man, leisure and wildlands into sharp focus. A very fortunate combination of topography, climate and vegetation found in the Southern Rocky Mountain physiographic province (Fenneman 1931:92), quality facilities, active promotion and advertising, public infrastructure investments and the continuing urban character of population and economic growth in Colorado have helped our skiing industry record a 205% increase in the number of lift tickets sold from the 1966-67 season to the 1973-74 season (Goeldner and Dirks 1975:3). The number of lift tickets issued by Colorado ski areas rose from 175,000 in 1950 to over 4.3 million for 1973-74 season (Goeldner and Dirks 1975:66). The rapid and sustained growth has, of course, profoundly affected Colorado's economy, particularly in those "ski counties." A recent study prepared for Colorado Ski Country USA concludes that skiing "has brought new prosperity to Colorado's Western Slope" and that "each ski county examined [Eagle, Grand, Gunnison, Pitkin, Routt, Summit] . . .has shown major improvements in socio-economic conditions over the past decade" (Dabney 1974:6). In contrast, however, an in-depth study of one of the most rapidly growing ski counties, Summit, concludes that increased environmental and aesthetic deterioration can be expected if present development trends there continue (Ulman, 1975:ix).

The issue, of course, is not a simple matter of weighing economic benefits against environmental costs. The complexity of this interaction is multiplied when we necessarily involve our needs, desires and values in determining how to manage our wildlands for the leisure benefits of man. The competition of needs, desires and values among different segments of our society was highlighted recently when the U.S. Forest Service proposed to designate 3,000 acres of the public domain at Beaver Creek near Avon, Colorado, for a winter sports site.

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[1]/ Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

[2]/ Resource Management Planner, Colorado Land Use Commission, 1845 Sherman Street, Rm. 600, Denver, Colorado 80203.

I am sure that most of us are familiar with the arguments over the air and water quality impacts of the Beaver Creek proposal. These arguments center around technical matters such as modeling assumptions and sampling procedures. What follows are comments that illustrate the less technical but perhaps more complex factors involved in making a decision on how we as a society should manage our wildland resources.

> The Beaver Creek site, like Vail, will help meet National, as well as International, demand for skiing.
>
> (U.S. Forest Service 1974:24)

> The impact of Vail in 1962 has caused a shift from an internal change process, which made life predictable and productive, to an external change process where change forces are put in motion by outsiders.
>
> (FUND 1975:4)

> The proposed new employment base [at Beaver Creek]. . .would provide job continuity and security for the local labor force. In turn, this would directly contribute to the stability of Minturn and Redcliff. It would favorably affect the stability of family life which is a primary value in the maintenance of the social structure and culture of these communities.
>
> (U.S. Forest Service 1974:22)

> Although the potential for employment stability in the resort industry is anchored to the residents of the Upper Eagle Valley, the present and predictable employment policies of developers and new business owners are systematically undermining that same employment base. . .The Upper Eagle Valley residents have been recruited for the low paying jobs, such as maids and janitors, while recruitment for better positions has been conducted in outside areas such as Denver. . .The new industry forced residents into a survival existence rather than providing opportunities for growth and affluence. In addition, the employment demands are causing the disorganization of natural family growth and survival mechanisms.
>
> (FUND 1975:9-10)

Economic indicators, such as unemployment rates, retail sales receipts, assessed valuation and so forth, give us only one dimension of the impact of "leisure developments." On the community and neighborhood level, there are potentially severe dislocations of cultural values and patterns of life, particularly in communities such as Minturn where "survival mechanisms" are based on an extended family structure rather than in a town governmental structure (FUND 1975:3). To those concerns on meeting recreational needs while maintaining community stability quoted above, we must add the following declaration of the 48th General Assembly of the Colorado Legislature:

> A more even and practical geographic distribution of industrial growth and governmental activity would reduce the continued concentration of industry and would stimulate the growth and development of less heavily populated sections of our state, thereby encouraging a more diversified and better balanced distribution of our inhabitants, and facilitating the restoration and protection of the quality of our environment, thus enhancing and enriching the lives of all Coloradoans.
>
> (Senate Joint Resolution No. 24)

From a statewide perspective, leisure developments offer an opportunity to alter Colorado's unbalanced population and economic growth trends that find sprawling growth along the Front Range even as 32 of our 63 counties declined in both population and business activity between 1950 and 1970 (Colorado Rural Development Commission 1972:11).

It was to achieve this delicate balance among competing needs, desires and values that Governor Richard Lamm issued an Executive Order on May 20, 1975, directing preparation of the Colorado Winter Resource Management Plan. The Executive Order directed the Colorado Division of Planning, "with the assistance of other State agencies and in cooperation with Federal and local agencies and private organizations," to formulate:

1. State guidelines for impact analysis of winter recreation development;
2. Alternative policies for the development and conservation of the State's winter resources; and
3. Alternative management policies for the State's natural resources, economic growth and human settlement patterns.

(Lamm 1975)

By the same Executive Order, Governor Lamm created a Citizen Advisory Board and a Technical Working Group to help the Division of Planning develop the guidelines and management policies for our winter resources. The Board, which is chaired by Penny Lewis of Copper Mountain, provides a forum for public input, but more importantly, brings together the diverse expertise and viewpoints of nineteen citizens who have witnessed the remarkable growth of the skiing industry in Colorado. Some of the Board members have directed and some have opposed this growth, but all share a concern that we achieve a sensible balance between utilization and conservation of our resources, between economic growth and community stability, between local prerogatives and statewide concerns. The Technical Working Group is made up of representatives from seventeen State agencies, four Federal agencies, and twelve local (regional, county and municipal) planning agencies and will assist the Division of Planning on the technical aspects of the Plan.

I will not describe the Plan further because detailed information on the Plan is readily available from the Division of Planning. My concern, rather, is to establish that the effort we are expending to prepare a Winter Resource Management Plan for Colorado is a legitimate exercise of State responsibility. What follows are my personal views on the State's role and responsibility in the management of our natural and socio-economic resources as it relates to the winter recreation industry. It was to the surprise of the U.S. Forest Service and to the dismay and suspicion of private industry and local government that, first, former Governor Vanderhoof and, later, Governor Lamm opposed the designation of Beaver Creek as a winter sports site. To put it simply, Colorado was not willing to accept without questions the creation of another Vail in the Upper Eagle Valley, even though this business-as-usual decision by the U.S. Forest Service was promoted by an environmental impact statement. After the initial impasse, we have met with representatives of the other three parties involved in the Beaver Creek controversy (the U.S. Forest Service, Vail Associates and Eagle County) and have made some progress on resolving these differences. The preparation of the Winter Resource Management Plan was initiated by Governor Lamm to provide the basic framework of policies, criteria and procedures by which the State of Colorado will assess and respond to major winter recreation development proposals, such as Beaver Creek, in the future.

When the State became involved in the Beaver Creek fracas, the surprise was due to our so-called 11th hour entry; the suspicion, however, runs to the deeper issue of governmental relationships and prerogatives. I think that the "late entry" charge recedes in memory and diminishes in importance as we discover serious unresolved questions on whether or not the identified impacts of the proposal can be satisfactorily mitigated. For example, the "planned measure" identified in the final environmental statement (Forest Service 1975:61) to preserve a 1,000 acre elk winter range area through cooperative agreement among the Forest Service, the Bureau of Land Management, the Colorado Division of Wildlife, and private land owners was found in the course of our discussions to be without contractual obligations and terminable by any party with 30 days notice. In passing, I would like to point out that the Forest Service was notified eight months before designation was made, in April 1974, by the State Clearinghouse that the draft environmental statement for the Meadow Mountain Planning Unit (which includes the Beaver Creek Management Unit) was seriously deficient and that the decision to designate a winter sports site at Beaver Creek deserved reconsideration.

The suspicion that State government in responding vigorously to the Beaver Creek proposal and in preparing a Winter Resource Management Plan is infringing upon the prerogatives of local government and private industry deserves more extensive discussion. My effort to allay this suspicion will be based on three premises:

1. There is not only specific authority but a clear obligation in Federal laws and regulations for the State to respond to such proposals as Beaver Creek;

2. Under Federal law there is a specific charge to the State to protect its water and air quality which necessarily involves land use planning and regulation;

3. There is clear mandate from the Colorado Legislature for the State to involve itself in matters such as those raised by the Beaver Creek proposal and to plan for the management of its resources as we are attempting to do with the Winter Resource Management Plan.

The Federal laws mandating State response to such matters as Beaver Creek are the Intergovernmental Cooperation Act of 1968 and the National Environmental Policy Act of 1969. Title IV, Section 401 (a), of the Intergovernmental Cooperation Act authorized the President to "establish rules and regulations governing the formulation, evaluation, and review of Federal

programs and projects having significant impact on area and community development" and established basic objectives for Federal programs. These objectives include "wise development and conservation of natural resources, including land, water, minerals, wildlife, and others; balanced transportation systems. . .; protection of areas of unique natural beauty, historical and scientific interest; properly planned community facilities, including utilities for the supply of power, water and communication. . ." The attainment of balanced transportation systems, the wise development and conservation of land, water, mineral and wildlife resources, and proper planning for power, water and communication facilities clearly requires and active State role in the review and evaluation of Federal programs. On November 8, 1968, President Nixon delegated the authority granted to him in Section 401 (a) to the Bureau of the Budget (later Office of Management and Budget) which resulted in the promulgation of the now-famous Circular A-95.

Among the provisions of Circular A-95 (revised November 13, 1973) are the responsibilities of clearinghouses in reviewing proposed Federal or federally assisted projects. The State Clearinghouse is to comment and make recommendations on, among other things, "the extent to which the project is consistent with or contributes to the fulfillment of comprehensive planning for the State" and on the "extent to which the project contributes to the achievement of State, areawide, and local objectives and priorities relating to natural and human resources and economic and community development, as specified in Section 401 of the Intergovernmental Cooperation Act of 1968 (Part I, 5 (a) (c)). The need for comprehensive State planning for resource development is clearly implied in both the Act and the Circular.

The National Environmental Policy Act of 1969, more often referred to as NEPA, established national environmental policies to achieve and maintain "productive harmony" between man and nature (Title I, Section 101 (a)). To help implement these policies, NEPA requires each agency of the Federal government to prepare an environmental impact statement for all "major Federal actions significantly affecting the quality of the human environment" that it proposes to undertake (Section 102 (2) (c)). By Executive Order, President Nixon directed the Council on Environmentmental Quality (CEQ) to issue guidelines to Federal agencies on the preparation of environmental impact statements. CEQ guidelines stipulate that "each agency shall interpret the provisions of the Act [NEPA] as a supplement to its existing authority and as a mandate to view traditional policies and missions in the light of the Act's national environmental objectives" (Federal Register 38:20551). This directive from the CEQ, authorized by Executive Order of the President, broadens the responsibilities of all Federal agencies by requiring them to recognize the "critical importance of restoring and maintaining environmental quality to the overall welfare and development of man" (NEPA, Sec. 101 (a)). In Colorado, where over one-third of our total land area is in the public domain, we are particularly concerned with the application of NEPA to the traditional land management programs of the U.S. Forest Service and the Bureau of Land Management, which together manage over 38 million acres in our state (Ulman 1975: 13). The two agencies have responded very positively to NEPA and are engaged in extensive and intensive environmental resource inventory and planning. The accelerated planning activities of the Forest Service and the BLM make it essential for the State to develop its own policies on resource and environmental management so that we can participate in and benefit from Federal planning, but also so that we can clearly delineate those State interests and concerns that should not be overlooked and overwhelmed by "overriding national interests." To cite just two examples, the State is developing policies on energy resource management through the Energy Policy Council in the Governor's Cabinet and on winter recreation through the Winter Resource Management Plan.

The Federal mandate for State responsibility in air and water quality management planning is quite specific and requires active involvement of the State in land use, social, and economic planning. In air quality control, the charge is clearly stated in Section 107 (a) of the Clean Air Act (42 U.S.C. 1857 et seq.):

> Each state shall have the primary responsibility for assuring air quality within the entire geographic area comprising such state by submitting an implementation plan for such state which will specify the manner in which national primary and secondary ambient air quality standards will be achieved and maintained within each air quality control region in such state.

Furthermore, Section 110 (a) of the Act requires that the State implementation plan include "measures as may be necessary to insure attainment and maintenance of such primary or secondary standard, including, but not limited to, land-use and transportation controls." The Clean Air Act clearly establishes State responsibility in developing and enforcing land-use and transportation control measures to achieve and maintain air quality standards.

As with other environmental legislation, the emphasis in implementing the Clean Air Act has been to bring problem areas into compliance with Federal standards. The State Clearinghouse found that environmental impact statements prepared for development proposals in areas exceeding Federal air quality standards conveniently ignored the obvious fact that these standards were established to improve air quality in problem areas and were not intended to be permissible pollution levels to be attained in areas enjoying clean air. The matter is succintly stated in the "non-degradation clause" of Colorado's Air Quality Implementation Plan, which was submitted to the Environmental Protection Agency on January 26, 1972:

> It is hereby declared to be the policy of the State of Colorado that in those areas where existing air quality is better than ambient air quality standards, such existing air quality will be protected, and significant deterioration of Colorado's air resource will be prevented.
>
> (Colorado Department of Health 1972:47)

Recently, the focus of attention in the Clean Air Act has shifted to the more subtle and complex issues of indirect source control and prevention of significant deterioration. Regulations promulgated by EPA in both areas will require consolidation of land use and transportation planning with air quality control and maintenance programs. Of the two, however, prevention of significant deterioration is more immediately relevant to our discussion. In response to a court order (Sierra Club v. Ruckelshaus, District Court, District of Columbia, affirmed by the U.S. Supreme Court) EPA disapproved all State implementation plans (Federal Register 37:23836) to the extent that these plans did not specifically address the problem of permitting or preventing significant deterioration of air quality in any portion of the State where the existing air quality is better than one or more of the secondary standards. Subsequently, EPA promulgated regulations (Federal Register 39:42510) which establishes a regulatory framework through which the States can determine what constitutes significant deterioration.

EPA regulations on prevention of significant deterioration establish "three 'classes' of different levels of allowable incremental increase in total suspended particulate matter (TSP) and sulfur dioxide (SO_2)" (EPA 1975:i):

> Class I applies to areas in which practically any change in air quality would be considered significant;
>
> Class II applies to areas in which deterioration normally accompanying moderate, well-controlled growth would be considered insignificant;
>
> Class III applies to those areas in which deterioration up to the national standard would be considered insignificant.
>
> (EPA 1975: i)

As of January 6, 1975, all areas of the country were designated as Class II areas with the provision that states (as well as Federal Land Managers and Indian governing bodies) may request redesignation to Class I or Class III. These regulations are particularly relevant to the future of winter recreation in Colorado since most of our existing and potential new ski developments are located in areas which qualify for Class I redesignation. Indeed, pristine air quality is a necessary concommitant to a quality skiing experience. It is in the implementation of these regulations that the cutting edge between State resource management planning and local land use regulation may well be found as one study shows that Colorado mountain valleys are "10 times as more sensitive to air quality impact as Denver" (Reeser and Kirkpatrick n.d.).

To redesignate an area, the State must consider:

> (1) growth anticipated in the area;
>
> (2) the social, environmental and economic effects of such redesignation upon the area being proposed for redesignation and upon other areas and States; and
>
> (3) any impacts of such proposed redesignation upon regional or national interest (Federal Register 39:42515).

EPA guidelines on redesignation encourage a statewide classification approach to allow the most complete impact analysis of redesignation (EPA 1975:35). Further, the guidelines stipulate that the states must weigh "different and sometimes competing state/regional/local interests" and that "it is the role of the states to balance varying needs and to decide which factors are most critical in each area" (EPA 1975:36). In preparing the Winter Resource Management Plan, we will identify the critical social, environmental and economic factors which are relevant

to winter resource management and, in doing so, will help establish criteria for redesignation.

In water quality control, Federal law also mandates a strong central role for the states. Again as a result of a court order, EPA has promulgated proposed regulations (Federal Register 40:29882) to implement Section 303 (e) of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.), which requires that each state prepare a planning process which provides for, among other things, "the coordination of the state's water quality management planning with related Federal, state, interests, and local comprehensive, functional, and other developmental planning activities, including land use and other natural resource planning activities . . ." (Federal Register 40:29884). As with air quality, Colorado's Water Quality Standards contain an explicit antidegradation provision:

> Waters of the state, whose quality exceeds the limits set in these standards, shall be maintained at existing quality unless and until it can be demonstrated to the State that a change in quality is justified to provide necessary economic or social development.
>
> (Colorado Water Quality Control Commission 1974:2)

Although criteria to determine when a "change in quality is justified" have not been established, proposed EPA regulations require that "Statewide antidegradation policy and methods for implementing such policy" (Federal Register 40:29889) be included in the State water quality management plan which must be submitted to EPA for "pre-adoption review" no later than July 1, 1978 (Federal Register 40:29888). Again, as with air quality, the State, after full public participation and close intergovernmental coordination, must strike a delicate balance between economic and social development and water quality in our mountains, where pristine streams provide both impetus and constraints to such development.

Federal air and water quality laws clearly require a central State role, particularly in relating air and water quality management to land use planning and economic and social development. Another important Federal law that thrusts the State into its central planning role is the Housing and Community Development Act of 1974, particularly in its amendments to Section 701 of the Housing Act of 1954, which, of course, provides for comprehensive planning assistance. Department of Housing and Urban Development (HUD) regulations to implement these amendments place emphasis on coordinated intergovernmental planning within states. The regulations specifically require that states "submit a single application (Overall Program Design) which shall include sections for statewide planning and for all substate applicant categories (large city and urban county, metropolitan, nonmetropolitan and locality)" (Federal Register 39:43384). The central role that HUD has placed upon states is clear and unequivocal:

> It is HUD's intent to give States major responsibility and discretion, in consultation with substate applicants, for administering a program of planning and management assistance for substate applicants required, or electing to apply, to the State and providing comments to HUD on substate applications submitted directly to HUD.
>
> (Federal Register 39:43385)

The new HUD regulations also require each recipient to prepare a comprehensive plan which "shall include, as a minimum, a housing element and a land use element . . . " (Federal Register 39:43382). No grant will be made to any applicant after August 22, 1977, unless the two required elements are completed. All substate recipients must include, among other things, the following items as part of the land use element within the State's overall program design:

> Long and short term policies...where growth should and should not take place;
>
> The type, intensity and timing of growth;
>
> Studies, criteria, standards and implementing procedures necessary for effectively guiding and controlling major decisions as to where growth shall and shall not take place.
>
> (Federal Register 39:43383-43384)

Finally, the new regulations require each substate applicant applying directly to HUD to "submit a copy of its Overall Program Design [OPD] to the Governor...to provide the Governor (or his designee) an opportunity to comment on the relationship of the applicants' OPD to the policies and objectives in the applicable section of the State OPD" (Federal Register 39:43386-43387).

Preparation of the Winter Resource Management Plan will help Colorado meet some of its obligations under Federal environmental quality regulations and planning assistance programs. There is also clear mandate in the statutory law of Colorado for the kind of resource

management planning that we have undertaken. The Division of Planning is specifically authorized to:

> Make studies and inquiries relevant to State Planning of the resources of the State and of the problems of agriculture, industry, commerce, as well as population and urban growth, local government, and related matters affecting the development of the State. (Colorado Revised Statutes 24-32-203 (1)(e)1973, as amended.)

Furthermore, in the legislative declaration creating the Colorado Land Use Commission, we find the following statement:

> It is the intent of the General Assembly that land use, land use planning, and quality of development are matters in which the State has responsibility for the health, welfare and safety of the people of the State and for the protection of the environment of the state. (C.P.S. 24-65-102(2), 1973, as amended.)

State law also establishes that the prevention, abatement and control of air and water pollution are matters of statewide concern. I refer you to C.R.S. 25-7-102 and 25-8-102, 1973, as amended.

I think it is safe to conclude that Federal and State law not only mandate that Colorado take a strong central role in land use and environmental planning, but also that we take a comprehensive and intergovernmental approach. Environmental protection, resource development and social-economic growth can no longer be addressed separately but must be incorporated into comprehensive planning processes and implementation programs. The Winter Resource Management Plan is a pilot program to develop a process that will enable Colorado to guide the development of a large portion of the State whose physical and social environment is extremely delicate.

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Procedures for Improving Public Involvement in Land Use Planning and Decision-Making[1]

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Abstract.--This project began as a questionnaire-based study of public involvement techniques employed by the Coconino National Forest. More effective public involvement procedures were the intended result. The paper describes the original project, deals with issues arising from a decision not to allow the questionnaire, and ends with a description of the current, revised study.

INTRODUCTION

As I understood the Forest Service's intentions regarding my project, they were to recruit a social scientist from outside the agency to study, to evaluate, and if possible to improve upon, the public involvement mechanism the Service employs. Accordingly, my first task as an Eisenhower Consortium Fellow was to review Forest Service public involvement practices. I studied them using two techniques: (1) analysis of all pertinent agency literature on both the management-oriented "how to involve the public" problem, and also of the research-on-public-attitudes variety; and (2) observation of the experience of the Coconino National Forest. I had participated as an interested citizen in certain public involvement experiences concerning that forest, and had served as a member of its Multiple-Use Guide Review Committee. Informed in March, 1974, that I had a good chance to receive a Fellowship, I began this review process.

My conclusions, stated in a Project Statement in June, 1974, when the Fellowship commenced, justified the approach to the project that I felt was most appropriate. They were as follows; I was impressed by the seriousness with which the Service had taken the growing necessity of dealing with the public during the process of decision-making. Our political system had changed dramatically during the 1960s moving away from the indirect, delegation-of-authority type of politics, in which a passive public waits for an electoral opportunity to change policy directions. The concept of involving the citizenry, particularly emphasizing the ongoing process of public consultation, had enroached heavily by 1970 on the traditional, indirect style of American democratic government. (Milbrath, 1965; Bowman and Boynton, 1974; Parry, 1972; Cobb and Elder, 1972; Barber, 1972; Verba and Nie, 1972). [3/]

The Forest Service, like other land management agencies, has been confronted by this change in the style of our democracy. The problem facing the Forest Service has been summarized as follows:

> Most administrators are suspicious of politics, so they try to transform a political or policy decision into a professional, technical decision. This

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[3/] The study of political participation, as represented by these works, does not mean the same thing as "participatory democracy," a pet theme in New Left literature. The latter theory advocates decision-making from the bottom up, a situation which is, to say the least, hard to conceive of in advanced, high-technology societies. A sample is Benello and Rousopoulos (1971).

> tactic ensures that the political decision will be poorly made...
>
> Actually most decisions have components of both Professional and Policy Decisions; the task is to isolate them and behave appropriately for each part of the decision. (Behan, no date:49-51).

CURRENT FOREST SERVICE PUBLIC INVOLVEMENT PROCESS

Forest Service documents indicate that the agency had committed itself firmly to facing the political aspects of public involvement. (USDA, Forest Service, 1971:1). National Forest administrators have attempted varied techniques and used several media for involving elements of the public that are concerned with decisions affecting the management of National Forest resources. Yet, in my view, there is no concensus that the currently existing procedures for public involvement are satisfactory to the public, or to the Forest Service. Hence, there is no apparent confidence that unexpected controversies and expost facto confrontations over important issues of forest management can be avoided by procedures for public input that would ensure politically viable decisions. (Hendee et al., 1973:13)

Unfortunately, there is some evidence that in spite of their efforts, the Forest Service has been involved in confrontations that might have been muted by better public consultation. The Forest Service's multiple-use management charge entwines the agency in resource allocation arguments it cannot avoid, but must try to moderate so that wise management decisions emerge. Nationally, the controversy over Mineral King development, the clear-cutting issue in Bitterroot and other Western Forests, and the continuing battles over primitive area inclusions into the Wilderness category, are just a few of the examples one can cite to show the completeness of the agency's immersion into politics.

On the local level, I concluded that the Coconino National Forest has tried hard to carry out effective public involvement, but has sometimes not succeeded. It is probable that earlier and more systematic public involvement could have defused the emotional debate over resort development on the San Francisco Peaks. More public involvement might have produced stronger support for Sycamore Canyon Wilderness, and for the 10-year timber cut, as well as public condemnation of the decision to keep the forest open during 1973's disastrous fall fire season. Most vividly, widespread public involvement in the fall of 1971 when all the elaborate planning for the Mormon Lake Road improvement was finalized could have alleviated a painful and costly false start when the roadway became an issue during its construction in 1972.

Thus, my first conclusion was that the Forest Service is not confident in the effectiveness of its public involvement procedures, and that events have often justified their concern. My second finding was that the techniques for involving those members who happened to have been identified, or who had stepped forward as interested in an issue, were far more advanced than were the methods of identifying who was actually concerned.

Much ink had been spilled developing techniques for involving people after they had been identified. Forest Service manuals on the topic of involving the public describe a variety of techniques ranging from mass oriented to selective in their assumptions about which publics are to be involved. These techniques employ three basic communications formats; mass media, face-to-face contact and written inputs.[4/] The first of these formats includes procedures such as formal press conferences, less formal appearances by Forest Service administrators on news or local talk-type shows, and press releases. The mass vs. select distinction of which type of audience the agency's message impacts is not an important distinction with this format.

Face-to-face contact formats, the second type, are more clearly divisible along the "mass or leaders" spectrum. Formal Public Hearings and Open Public Meetings are opportunities to injest mass attitudes as well as elite views. Institutional group discussions and workshops are more often controlled-access (by invitation), and likely to be more interest group-leader oriented.[5/] This is also true with Ad Hoc Committees to consider specific issues, with show-me trips to view problem areas, and with private consultations with community leaders in which the line-officer deals with key personnel around the affected community. Advisory councils are also vehicles for face-to-face public input that have been used in the past. But as with any formal public committees or hearings, their use is now tightly controlled by the provisions of PL 92-463, the Federal Advisory Committee Act.

4/ Hendee et al (1973) list eleven collection techniques. U.S.D.A Forest Service (1974) lists 18. For a discussion of public consultation techniques that is very similar, but from outside the government, see Beech (1974).

5/ Wager and Folkman (1974) strongly advocate this format for consultation.

The third format, written input, also ranges along the mass-select scale. The Forest Service has used standardized questionnaires, based on random samples, collected both by personal interview and by mail.[6] Response forms attached to informational brochures and letter requests for general comments on a management problem have been directed at specific target groups rather than random sampled.[7]

Forest service officials are given no specific instruction as to when each of these techniques should be used. They do receive very explicit guidance as to the pros and cons of each technique, but are then told that with most management problems that appear to require public involvement, "several information processes" should be used. These methods for public input should be "chosen to best fit the situation." And, "all media should be considered." (U.S.D.A. Forest Service, 1974a: 13; Hendee et al, 1974: 16). In one sense, this is as it should be, because issues differ greatly, and the line officer who must make the decision must have latitude to employ flexibly his knowledge of the variety of procedures. But this situation also places a heavy burden on that decision maker. Which sections of the public should be involved? How? When?

It is possible that the absence of specific instructions about "what to do and when" stems from deeper problems regarding the purpose of public involvement. First, there is some evident confusion about the goal of public involvement in the official statements and intra-agency research reports on the topic. On the one hand, a feeling exists that there is something unfair about using public involvement to ward off political controversy; that there is something cynical about such a motive. Hendee et al reported that to "develop support for current Forest Service plans" for roadless areas was only a "ringer" item on their questionnaire. They stated, "we do not regard (developing support for current Forest Service plans) as a legitimate objective for Forest Service public involvement." (Hendee et al, 1973: 16) But later the authors state "more involvement can result in better acceptance of a final decision, because fewer people will feel they were excluded. More involvement lends credibility to the whole effort." (Hendee et al, 1973: 24) [8] Is this not the development of support? Such confusion is surely unnecessary. The molding of a favorable climate for public policies is certainly a valid function for public involvement. One of the rationales underlying this project was that more effective public participation will result in greater public acceptance of the compromises that multiple-use management requires, and thus in greater legitimacy for that administrative service in the public mind.

A second type of confusion thrives on the question of whether the information and involvement program should concentrate on those citizens who are highly articulate, and therefore can be expected to make their views known, or whether the program should be more geared toward quantitative weighing of public views. The disagreement over which role the technique of content analysis might play serves as an example: In placing this technique into perspective, the editor of A Guide to Public Involvement in Decision Making stated that, "The quality and validity of the comments are much more important than the number of people who offer them." (U.S.D.A. Forest Service, 1971: 20). But, contrast this view with:

> the committee often heard officers say, "We want quality not quantity." We disagree with this. We want quality and quantity in public involvement. There is no inherent reason why the quality of public input needs to go down as the number of participants increases. (Hendee et al, 1973: 24)[9]

Thus, there are ambivalent feelings over: (1) whether the Forest Service should be eliciting public comment that may change decisions, or molding a support sector for decisions that are already set, and (2) whether the comments of the articulate few are more valuable than numerical counts of mass viewpoints. These are joined by a third ambivalence: many Forest Service officers are not sure whether they should be involving everyone whom they think might be affected, or just those people already concerned. It is this researcher's impression that the Information and Education functions of the Forest Service have not been clearly differentiated from the activities of Inform and Involve Programs. Public Involvement and the Forest Service, an administrative study by the Forest Service, calls on the agency to:

> Increase efforts to identify disadvantaged groups and explore how national forest resources can benefit them. Make special efforts to obtain their

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[6] Bultena and Rogers (1974) make a very strong case for this technique.

[7] Hendee, Clark and Stankey (1974) extoll written formats for public involvement.

[8] See also the argument that the Forest Service must not abdicate its responsibility for good decisions by overemphasizing public input (Nelson, no date).

[9] A very negative view of the "numbers game" is found in Nelson (no date).

views on issues that affect them. Recruit more members of minorities to help in these contacts. (Hendee et al, 1973: 79).

Certainly, Information and Education (I and E) programs are essential ways of molding public understanding and acceptance for administrative decisions. Through such programs the sections of the general public who know something of the activities of the agency are broadened to include groups who had not previously been aware of the Forest Service's role. Such I and E programs also have the desirable feature of generating feedback so that the agency can, in turn, serve a broader public in the future. For the Forest Service, for example, I and E efforts have concentrated recently on involving urban people, particularly racial minorities, in possibilities for recreation and environmental education that employ national forest resources. Thus, a basic precept of I and E programs is that "the Forest Service should strive to involve as many citizens as possible who are potentially affected by a resource decision or interested in it." (Hendee et al, 1973:24).

The problem is that Information and Education Programs are not adequately distinguished from the purposes of Inform and Involve, a program designed to bring already concerned elements of the public in on current decisions. The Forest Service line officer's choice of whether to use a mass-oriented or leader-oriented approach to an issue (whether to use a random sample survey or consultations with concerned interest group leaders) is closely related to this third confusion.

My research project was directed at improvement of Inform and Involve techniques. It was not directly concerned with Information and Education Programs per se: e.g. with the involvement of groups that have been described as "less interested in the national forests than they ought to be." Naturally, I agree with the statement that "the more people that are involved, the better." (Hendee et al 1973: 23). However, my project was to concentrate on sectors of the public that are already involved. The practical side of readiness for politically important issues as they arise should be directed toward those members of the public who already care.

Thus, to summarize my findings as I reviewed the agency's public involvement practices and prepared to commence my own study, the agency has taken public involvement seriously, but has not, by any means, constructed a system that can be counted on to allay controversies; that the major gaps occur in the area of identifying who should be involved; and, finally, part of the problem may stem from confusion within the public involvement concept.

ORIGINAL METHODOLOGY PLANNED FOR THIS PROJECT

My solution for the state of affairs described above was to propose a more systematic technique for pre-identifying those people who would be likely to react to controversial decisions. By February, 1975 I had arrived at a methodology that was mutually agreeable to the Rocky Mountain Forest and Range Experiment Station officials.

This methodology was based on the premise that if the National Forest Administrative officer could systematically identify those people who are likely to be concerned with forest management problems "at the earliest possible stage of (U.S.D.A. Forest Service, 1974a:5) disputed management issues, and then contact and work with those individuals on compatible solutions to the problem, serious disputes and criticisms of the decisions would be softened. More politically compatible solutions would result. I assumed that truly constructive and vigorous public input would come from those members of the public for whom such issues have high saliance.

It seems obvious that a major reason for the surprises the Forest Service receives (in the form of public clamor over a decision that was supposedly subjected to public scrutiny) is that some of the concerned public were not heard from. These people may have desired to offer input, but did not hear of the impending decision in time to make their views known, or did not hear enough about it to realize that it affected them. The only way to ensure an environment in which final decisions can be confidently announced is to know that the most exhaustive process for recruiting public input has been carried out.

I developed an interview schedule that evaluated saliance of forest resource management issues for the respondents. As a member of what I called the "Concerned Citizens file," each respondent's interest in forest management problems (relative to other issue-categories) was to have been recorded, as well as the respondent's level of interest in certain categories of Forest management problems over others. Basically, the Forest Service has been waiting until a management decision comes up, then deciding how to go about public consultation. With a more sophisticated "concerned citizens file" already prepared, the Forest Service would have a greater chance of going to the right people, rather than

hoping that somehow the people who genuinely care about an issue would become aware of it, and would respond.

I knew that there were dangers in any inform and involve procedure that were worth watching. First, there was the danger of over-working the public. (Nelson, No date: 4). Using the concept of saliance, the "concerned citizen file" should have had a built-in protection against this danger in the prior identification of genuine interest in the issues. It has been popular to assume that Americans are not very politically minded, are ill-informed, and that they can be easily alienated by over-involvement. However, some political scientists have argued that the public is not as politically irresponsible or disinterested as we have tended to assume. New research indicates that "many more Americans have true attitudes on issues of public policy than previously had been concluded." (Pierce and Rose, 1974: 646). It may be, as Pierce and Rose argue, that earlier measures of public information levels and participation were faulty, and failed to measure the real levels of political knowledge and caring. Or, it is possible that (as defenders of the earlier measures retort) "the voter has been rehabilitating himself," e.g., people are simply better informed in the 1970's than they were before. Whatever the reason, genuinely interested and informed citizens will be harder to alienate with overexposure. (Converse, 1974:660).

My questionnaire was designed to assemble data on three subfiles of concerned citizens: commercial users, recreational users, and concerned non-users. If previous accumulated evidence concerning political behaviour was any guide, the first direction in which to search in order to identify systematically members of the public for whom forest management issues would have high saliance was actual usage of the forest's resources. "Users" of varied types would compose a high proportion of the concerned public for any particular national forest. Not all people who use the resources will be politically active in public issues that arise, for many people lack the sense of citizen competence that is necessary for public involvement. Their only political act is (possibly) voting. But, surely the first place to look for people who are directly affected is among commercial "users." An identification list of the forest's varied users was to be compiled through the commercial use permit system. For the Coconino, a computer printout was available that lists active commercial use permits. These number about 800, but elimination of double or multiple entries reduced the number of individual commercial users to less than 500. The questionnaire would have provided data on the type of permit and its relative importance to the permittee's total economic activity.

A list of recreational users would have been more difficult to compile. The campground fee system would provide identification when registrations were dropped into collection boxes. I had intended to add day-users to the list with license number checks at high day-use areas. Finally, those in charge of group recreational use programs (scouts, churches, etc.) would be contacted. As with the commercial users, the compilation of this subfile was to proceed on the basis of a universe of all recreational users of Coconino National Forest. All registrants in the Coconino National Forest's 23 campgrounds and a sample of day-users were to be sent the questionnaire.

Concerned non-users would compose the third subfile that were to be included in the concerned citizen file. In one sense, of course, the person who cares about wilderness (though unable to visit it), is a consumer of forest values. (Darling and Eichhorn, 1970). The problem was to identify them from the general public. First, civic organizations, environmental groups and sportsmen's organizations were to be visited by the researcher and informed of the opportunity for concerned citizens to make their interest known. They would receive the questionnaire. The basic purpose of these procedures was to ensure that interested people who are not users would have been added to the file. Assuming that those people who have participated in past deliberations over forest resource problems would still be concerned, anyone who had served on Ad Hoc Committees or attended past meetings would be contacted.

Up to this point, the subfile descriptions were not based on sampling, but rather on a population: the probable source groups for most concerned citizens. A stratified random sample from Flagstaff and other communities adjacent to Coconino National Forest (Payson, Williams, Sedona, Winslow), was to be used to identify sectors of the population that might produce concerned citizens who were being missed by the above methods. The basic technique was to be a mail survey. This sample of approximately 400 was crucial to the study's potential to draw statistical inference pertaining to the unique qualities of concerned citizens as a part of the general public that inhabits the Coconino National Forest's immediate surroundings. It was also the only way to draw conclusions about the general public's evaluation of methods the Forest Service has been using in the past to contact the public. The questionnaire would have allowed an evaluation, through

this sample, of how the general public of the area rated various public consultation techniques. The final step in surveying the general public was to be a formal request, through the media and through civic organizations, to the effect that "anyone interested enough in the forest management issues to want to be consulted, but who has not as yet been contacted through the questionnaires distributed to users, should get in touch with the director of the survey." Those who responded to this notice, would be sent the questionnaire, and their response data added to the concerned citizens file.

The questionnaire summarized necessary background information for identifying the personal characteristics of the respondents: their educational, occupational, social and familial status. Other questions identified vacation preferences and gave an indication of the recreational importance the Coconino National Forest for the respondent, on leisure time preferences in the Coconino, and on economic use. These categorization potentials were necessary in order to select for public involvement (from the data file that resulted) the appropriate group of citizens for a forthcoming issue. Other parts of the questionnaire gave data evaluating the public consultation methods used by Coconino National Forest in the past, and indicated preferences of the respondents who were about to be consulted for various consultation formats.

The three subfiles described above were to be combined (with their separate identities retrievable when necessary) into the Concerned Citizen File, with the data punched onto card input that could be manipulated with existing statistical program packages. The subfiles would be ready when an issue of political importance arose. A set of instructions was to have been compiled so that the Forest Service staff officer could easily use the file on a computer or by hand. For example, an issue dealing with predator control would call for consultation with those who indicated an interest in the topic. The answers of that same group might also have indicated a clear preference for certain among the formats for carrying out public consultation. (Those who are interested in predator control problems may also have perferred the open meeting format; say, by a 4-1 margin). Forest Supervisor's offices in more remote areas could handle the information through a variant of "Codinvolve," an information classifying and retrieving system now being disseminated within the Forest Service, which uses manual techniques of sorting.

The concerned citizen file was to be in easily intelligible form, readily accessible to the public, in conformity with the December 31, 1974 Invasion of Privacy Act. A distinct advantage of the Computerized Concerned Citizens file as a way of consulting the public was the system's "traceability." According to the Forest Service's own research social scientists:

> Public involvement must also be traceable so that an independent second party can determine how input was collected, analyzed, and evaluated...Decisions based on some intuitive "feel" for public sentiment are unacceptable because they are not susceptible to public review.(Hendee et al, 1974:63).

Users who stated that they were unconcerned and did not wish to be bothered would be placed in an "inactive file." It may be that quite a proportion of the recreational users would wind up in this category. This file could be useful in the event that decisions arise which seem to be extraordinary significance. In such a case, a communication to the "non-concerned user" group might turn up valuable input despite what that group earlier stated as their negative feelings about involvement.

The "concerned citizens" file would not be used only one, but would continue to exist as a system that could regularly be updated, and at far less expense than the original file construction represented. "Sorting out" into the inactive file would occur when respondents failed to answer several invitations to participate, having indicated previously that they were very interested in doing so. As I saw it, the benefits of this system would be considerable: avoidance of serious cases of non-communication between Forest Service and the public would produce greater legitimacy for the agency. Another long-range attribute of the "Concerned User" file method would be the collection, through assembling sets of data from the individual forests into a national or regional file, of valuable data on the concerns held by the public toward forest management in the broader context.

In summary, high quality participation and input will not come from the general public, but rather from those who are specifically concerned. To attempt to consult with people outside of this category is to spread administrative resources too thin. To consult fewer than those who are concerned is equally undesirable, if there is any way it can be avoided. The Concerned Citizens file left less to the intuition of the Forest Service officer and was therefore desirable.

The Questionnaire's Fate

The final project methodology was forwarded from the Fort Collins Station to the Washington Office, for, a questionnaire being included, ultimate approval by the Office of Management and Budget (O.M.B.) was required. In April, we were informed by the Director of Forest Environment Research (WO) that Statistical Reporting Service had advised the Forest Environment Research Section not to submit the questionnaire to O.M.B. Obviously, I have had to revise my approach to the project since April and will report on my current activities in the final section of this paper. At this point, given my experience, I think it is important to devote some attention to the situation which was uncovered by the decision from WO regarding my questionnaire.

CURRENT INVASION-OF-PRIVACY LEGISLATION AND ITS EFFECT ON FOREST SERVICE PUBLIC INVOLVEMENT ACTIVITIES

On the last day of 1974, President Ford signed into law the Invasion of Privacy Act (PL 93-579). Two weeks later, an O.M.B. memo brought the major provisions of the new law to the attention of all Federal agencies. The purpose of the act, as I interpret them, were to (1) make agency records on citizens retrievable and correctable by citizens themselves, (2) establish machinery for arbitrating disputes when a citizen has trouble "correcting" inaccurate records, (3) control access to records by preventing their sale to third parties, etc., (4) establish a Commission to pursue the study of Privacy problems further. Clearly, the emphasis of the legislation was summarized by a statement of Senator Ervin that "all federal data banks (should) be fully and accurately reported to the Congress and the American people." (Congressional Quarterly, September 28,1974: 2613). The intent of Congress was to establish public control over data collected by federal agencies. Congress did not intend to stop federal government from collecting information that is useful in carrying out policy. President Nixon, who had established the Domestic Council Committee on Privacy early in 1974, argued "If you can't justify it (data collection), stop it!" (Congressional Quarterly, March 16,1974: 683). We should note that his statement could also be read - "If your agency needs the data to carry out its job, don't stop it!"

In one provision (e,7), PL 93-579 prohibits agencies from maintaining any public record

> describing how any individual exercises rights guaranteed by the First Amendment unless expressly authorized by statute or by the individual about whom the record is maintained or unless pertinent to and with-in the scope of an authorized law enforcement activity. (O.M.B. 1975:28965).

My impression is that WO reasons for disapproving my questionnaire rested heavily on this statute. I think the decision deserves some serious examination, for it threatens even the degree of public involvement in which the Forest Service presently engages. To argue that PL 93-579 prevents the collection of data on relevant attitudes of citizens concerned with management of forest resources is, by logical extension, to disallow the present retention of a public record of open meetings, to require the destruction of letters written by citizens to a Forest Supervisor, and to mean dissolution of even the incomplete "contact files" most Supervisors' offices now keep (showing names and addresses of citizens who have shown interest in past problems).

I believe such interpretations are far from the Congressional intention of PL 93-579. Using the wording of the provision cited above (e,7), it is, to be sure, hard to find specific mention in Forest Service authorizing laws, of the necessity to maintain public records. But the provision (e,7) goes on to imply that such records are acceptable if they are essential to the agency's job. I suggest that there are previous laws which serve as evidence of a long-standing assumption that the Forest Service's role cannot be carried out without some system of recall for public views on management problems. For example, it is implied in NEPA (PL 90-190) Sections 101a, 102c and d that the Forest Service consult the public in order to conform its forest management decision to standards of environmental quality. Also, the Multiple-Use Sustained Yield Act of 1960, particularly in its inclusion of recreation values, implies consultation and analysis of public input. (U.S.D.A. Forest Service, 1974 b).

A more complete interpretation of the 1974 Invasion of Privacy Act became available on July 9, 1975, when O.M.B. released a statement on guidelines and responsibilities of federal agencies under the new law. This is the major document for clarifying questions that Forest Service officials may have developed about the impact of the law on public involvement activities. In the first place, it seems clear that the vast majority of current public involvement activity is seriously affected if PL 93-579 is taken literally. Generally, the Law's focus limits "systems of records", which are defined as any information about individuals, in any form, that is retrievable "by reference to an

individual name or some other personal identifier." (O.M.B. 1975:28952). This would exclude the vast bulk of letters to forest supervisors, statements at public meetings, and references in the press to concerned individuals: these inputs are, indeed, retained in Supervisors' offices, but they are filed under the issue concerned rather than under the citizens' names. Unfortunately, however, when the O.M.B. guidelines discuss Subsection e,7 of the Law, affecting peoples' First Amendment rights,the term "record" is used. (O.M.B. 1975: 28965). Thus, regardless of how the input is filed, a citizen's view on a problem of national forest management is not retainable for consideration in decision-making unless "the individual expressly authorized it."

In my opinion, we have here an interesting, though hardly unusual, political phenomenon: Congress has passed legislation designed not to stop the workings of government, but to limit pernicious uses of data on individuals. O.M.B. has, in my view, overstated the impact of PL 93-579 on everyday agency activities. For example, the legislation also states that agency functioning ought not to be adversely affected. Subsection e,1 of the Law acknowledges that agencies should maintain "only such information about an individual as is relevant and necessary to accomplish a purpose of the agency required to be accomplished by statute..." O.M.B. then goes on to admit, in the guidelines, that agencies need to maintain information about individuals to discharge their responsibilities effectively. (O.M.B. 1975: 28960).

To summarize my views on the matter, I do not think the Forest Service should stand in awe of the Invasion of Privacy Act. If I read correctly the intentions of Congress and of the people, the agency should surely be careful to use public input only in the ways that are made necessary by its forest resource management functions. The Service should be ready to show an individual what records pertaining to that person have been retained, be willing to correct any error in the record that individual brings to the agency's attention, refrain from selling to other organizations (for example, sporting goods companies) lists of people who use forest resources, inform Congress and O.M.B. about what records are being maintained, and refrain (if the occasion should arise) from treating a citizen who refuses to provide his Social Security number differently from a citizen who does so. But I do not think the Law prevents keeping records on public interests and inputs if the Forest Service feels they are necessary. Meanwhile, it might be wise for the agency to ask Congress for legislation defining clearly its public consultation powers.

THE PROJECT AS REVISED

My revised project description was filed June 1, 1975. I plan to investigate in as much detail as possible the recent history of public consultation on the Coconino. The main function of such an investigation is to sharpen the intuitive aspects of preparing for decision-making: the process must (necessarily, given current restrictions on more systematic techniques) remain highly intuitive.

The Coconino's experience in dealing with the public has been rich and varied, though no nationally-known controversies have resulted. I am reviewing this experience in its entirety for at least the past 15 years; a period covering the beginnings, development, and flowering of the current public-participation era. A preliminary survey of the issues that have resulted in some degree of public interest and controversy includes controversies in the area of recreation, inter-forest boundary reorganization, road development, timber resource management, grasslands management, water resource management, fire prevention campaigns and fire-caused closures, land exchange problems, land use plans, wilderness inclusions, wildlife, woodcutting, stumpwood and naval stores, and relations with city government of Flagstaff.

The study procedure is to evaluate each case in terms of its success or failure as an exercise in public involvement, and to try to find patterns in the conditions associated with successful cases. Other patterns will be identified whenever possible: What categories of citizens show interest in various types of issues? Do those categories seem more at home with particular media for public involvement? Unfortunately for the purpose of this paper, my revised research has just begun, and it is too early to report substantive conclusions.

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Development of Land Use Planning and Transportation Planning Systems for National Forests[1]

Reuben N. Weisz and Ross Carder[2/]

Abstract.-- This paper describes how emerging computer-aided planning support systems can be made operational. Some existing systems, linkages between systems and interfaces between systems and the U.S.D.A. Forest Service planning and decision-making process are examined. Current systems development problems are surveyed. A few solutions are suggested.

INTRODUCTION

This paper gives an overview of the current state of development of social and environmental planning systems for National Forests. While most of the papers presented at this symposium focus specifically on leisure home and resort development examples, this paper addresses the topic of "man, leisure and wildlands" at a more general level. Since all of the key words in the title of this paper have broad, general meanings, the point of departure for this discussion will be a definition of the key words.

National Forests

The National Forest System consists of approximately 187 million acres of federally owned forest, range and related lands that are managed and protected by the U. S. Forest Service. Approximately 40,000 U. S. F. S. personnel are engaged in one or more aspects of managing timber, water, range, wildlife habitat, and recreation resources; protecting these resources from fires, insects, diseases, and pollution; utilizing wood resources through the development of improved production, marketing and engineering methods; and surveying the capability, suitability, and feasibility of alternative means of employing the above resources within the structure of the existing and future socio-economic-environmental systems. U. S. Forest Service sponsored research provides a scientific base for all federal, state, and private parties engaging in the above activities, as well as cooperating with state and private owners of an additional 574 million acres of forest related land.

Systems

The National Environmental Policy Act of 1969 states that all agencies of the federal government shall "... utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and decision-making which may have an impact on man's environment..." This view is reflected in the letter and spirit of the Forest and Rangeland Renewable Resources Planning Act of 1974.

The dictionary (Woolf, 1973) defines a system as "a regularly interacting or interdependent group of items forming a united whole." The systems portrayed in this paper are related primarily to resource analysis, simulation or planning utilizing computer analysis and support techniques. They are conceived, developed or being adopted for use by the Forest Service.

Land Use Planning and Transportation Planning

Natural resources planning involves the development of goals, policies and procedures

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for an organized approach to exploiting, conserving and preserving the materials and capacities supplied by nature.

A number of important sounding, popular phrases essentially describe the same process. These include, but are not limited to, the following buzz-words--water resources planning, environmental planning and energy planning.

Two related, relevant concepts for national forest environments are land use planning and transportation planning. In land use planning, natural resource problems are placed within the context of the spatial pattern, mode and timing of land use activities. In transportation planning, natural resource problems are examined in the context of developing, maintaining, and regulating the use of multipurpose, multimodal transportation systems. In the National Forests, both public land use and access are regulated by the same organization, making a simultaneous land-use-transportation planning process feasible. And, since both land use planning and transportation planning are undertaken in the pursuit of the same objectives, merging these processes will have a synergistic effect on the overall problem solving capabilities of National Forest planners and decision makers.

UNIFIED PLANNING AND DECISION MAKING (UP & D)

Definition

Unified Planning and Decisionmaking: A Conceptual Framework for Forest Service Management by Carder and Oglesby (1973) documents current Forest Service thinking concerning the conduct of natural resource planning. (Ibid, p. 2):

> "...imagine the Forest Service operating in such a way that all its major decisions combine to bring about the effective use of the resources it controls, and that these are consistent with the intent and spirit of pertinent laws, directives, and other external constraints. Imagine further that the processes by which these decisions are reached are systematic, and are characterized as open, interactive, sequential, adaptive, and interdisciplinary. Also, imagine that these major decisions are made from a composite overall perspective that is multiobjective, multifunctional, multiresource, and multiyear. Finally, imagine that this decision making process is facilitated by advanced means of generating and communicating information. Such an approach places major emphasis on public interaction and inter-unit negotiation in all phases of planning and decision making, with the aim of achieving full participation and strong commitment --at all levels--to courses of action that reflect both top-level policies and priorities, and grass-roots needs and capabilities."

The Problem

The UP&D process necessitates efficient and effective means of acquiring/receiving, interpreting, displaying and transmitting information to planners and decision makers. The complexity and magnitude of the problem can be legitimately reduced to manageable proportions by sensibly employing sophisticated systems analysis techniques throughout the planning process.

The Chief of the Forest Service has stated (McGuire, 1972) that the UP&D concept "...provides a single frame of reference for the designers of systems and procedures to relate to and obtain guidance from throughout their development efforts." The purpose of this paper is to place the development of land use planning and transportation planning systems within this frame of reference.

EXISTING SYSTEMS

In the UP&D process, the primary focus of attention in the development of natural resource planning systems has shifted from developing and testing new systems to making selected existing systems fully operational and available for widespread use. Table 1 contains a partial listing of existing natural resource planning systems that is based on Row and Schmelling's (1971) catalogue of computerized systems in the U.S. Forest Service.

Row and Schmelling classified these systems into the following five categories:

A. Resource Information, Collection and Analysis Systems,
B. Resource Storage, Retrieval and Display Systems,
C. Resource Response Simulation Systems,
D. Resource Facility Design and Operation Planning Systems, and

Table 1. SOME OF THE EXISTING AND/OR DEVELOPING NATURAL RESOURCE PLANNING SYSTEMS.

A. RESOURCE INFORMATION COLLECTION AND ANALYSIS SYSTEMS

1. INFORM--Information for Management: a) Lands, b) Range, c) Recreation (RIM--Recreation Information Management), d) Timber, e) Transportation.
2. Forest Survey and Timber Management Inventories.
3. Compartment Examination and Inventory Systems.
4. STX--Individual Tree Measurement Samples.
5. Interpretation of Range Condition Trend Data.
6. Soil Resources Inventory.
7. Barometer Watershed Program.
8. Beaver Creek Hydrologic Data Processing System.
9. Streamflow Data Processing System.
10. Automated Weather Information System.
11. Precipitation Data Processing System.
12. Fuel Inventory System.
13. Dam Management System.

B. RESOURCE STORAGE, RETRIEVAL, AND DISPLAY SYSTEMS

1. FS-GIM--Generalized Information Management System.
2. GELO--Geographic Locator.
3. WRIS--Wildland Resource Information System.
4. TRIS--Total Resource Information System.
5. MIADS2--Map Information Assembly and Display System.
6. R3MAP2--Map Overlay and Display System.
7. AUTOMAP--Automatic Mapper.
8. IGEMS--Integrated Graphic Engineering Mapping System.
9. TOPAS--Topographic Analysis System.
10. CISC--Continuous Inventory of Stand Condition.
11. DRS--Data Retrieval System.

C. RESOURCE RESPONSE SIMULATION SYSTEMS

1. Timber Stand Growth and Management Simulation Models: a) PIPO TIMBERMAN (Ponderosa Pine Timber Growth and Management Simulator, b) PROGNOSIS (Model for Stand Development), c) TEVAP2 (Computerized Preparation of Timber Management Plans, d) TIMADS (Timber Management), e) TRAS (Timber Resource Analysis System).
2. Hydrologic Analysis Methods: a) ECOSIM--Ecosystem Component Simulation Models (General Terrestrial Water Balance and Yield, Surface Erosion, and Water and Sediment Routing), b) RCS--Resource Capability System (soil, water, and climatic event models), c) Subalpine Water Balance Model.
3. National Fire Danger Rating System.
4. Forest Insect Population Models.

D. RESOURCE FACILITY DESIGN AND OPERATION PLANNING SYSTEMS

1. RDS--Road Design System.
2. OPTLOC--Optimal Location (of roads).
3. Computer Design for Skyline Logging.
4. VIEWIT--Landscape View Delineation.
5. FOCUS--Fire Operational Characteristics Using Simulation.

E. MULTIPLE-USE AND ENVIRONMENTAL PLANNING AND DECISION SYSTEMS

1. RAM--Resource Allocation Model.
2. FRES--Forest Range Environmental Study.
3. RCS--Resource Capability System (Resource Allocation Analysis Package).
4. Economic Evaluation of Watersheds in the Southwest.
5. SNAFOR--Simulated National Forest Game.
6. MULTIPLOY--Forest Investment Simulation Language.
7. TAG--Transportation Analysis Group Models.
8. Scheduling Construction for Optimum Multiresource Allocation.
9. River Basin Planning.

E. Multiple-Use and Environmental Planning Decision Systems.

These categories are discussed in the following paragraphs.

Resource Information, Collection and Analysis Systems

These systems acquire information from air photos, ground surveys and sensing devices. The data is converted into a form that is suitable for computer storage and retrieval through keypunching, editing and other transformations. Information may subsequently be summarized, tabulated and displayed.

Resource Storage, Retrieval, and Display Systems

These systems may be used to process, store, retrieve, update, display, overlay and merge data in map form as well as summarize and tabulate data in report form.

Resource Response Simulation Systems

These systems project the state of a resource at some future time, or during some future time periods, based on a description of the resource state in the initial time period, and additional information on the rates of change of the state due to specific treatments and/or other stimuli that affect the resource.

Resource Facility Design and Operation Planning Systems

These systems may be used to plan and design facilities and operations for a single function or resource.

Multiple-Use and Environmental Planning and Decision Systems

These systems may be used to determine the "best" combinations of resource activities that are required to achieve stated goals and objectives for a given set of planning constraints.

LAND USE PLANNING AND TRANSPORTATION PLANNING SYSTEMS

An examination of Table 1 indicates that land use planning and transportation planning systems are really subsets of the total set of natural resource planning systems. Tables 2 and 3 give a more detailed description of some of the conceived, existing and/or developing land use and transportation planning systems.

LINKAGES BETWEEN SYSTEMS

Land use and transportation planning systems can be created by linking together separate, but related, subsystems from one or more of the major categories of natural resource planning systems. Figure 1, adapted from the Management Sciences Staff's Report II (MaSS, 1974b, p. 193), illustrates some of the potential interfaces between natural resource planning systems, land use planning systems and transportation planning systems.

In this figure, the outputs of the systems listed horizontally can provide inputs to the systems listed vertically wherever a black dot indicates a linkage. While some of the interfaces utilize direct linkages between computer programs, others require human intervention.

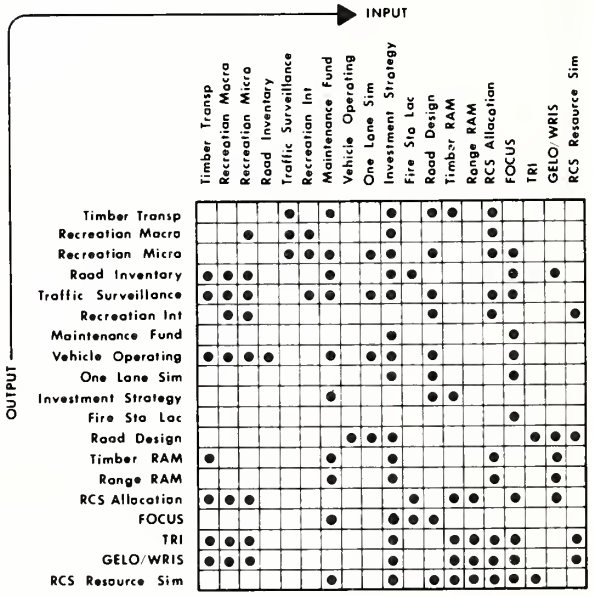

Figure 1.--Linkages between systems.

Table 2. AN OUTLINE OF SOME OF THE EXISTING LAND USE PLANNING SYSTEMS

A. Range RAM (Resource Allocation Method)	Assists in formulation and evaluation of range management programs.	Linear Programming
B. Timber RAM (Resource Allocation Method)	Assists in formulation and evaluation of timber management programs.	Linear Programming
C. RCS (Resource Capability System)	Assists in formulation and evaluation of land use strategies within the framework of a comprehensive planning system.	
1. Planning Framework	General, conceptual planning guidelines.	
2. Methodological Guidelines for Economic Analysis	Compilation of economic impact assessment methods and procedures.	
3. Resource Response Simulation Programs	Hydrologic and soils simulation programs. Can be used, either independently, or to generate input data for RCS Allocation Package.	
a. BURP	Computes water balances.	Hydrologic Models
b. PISCES-Water Yield I	Extends BURP by including soil moisture routing technique.	Hydrologic Models
c. SNMET	Models snowpack condition and snow melt process.	Hydrologic Models
d. EROSIN	Computes sheet erosion.	Hydrologic-Soils Models
e. ONEROS	Computes sheet, gully and soil erosion.	Hydrologic-Soils Models
f. DIRT	Similar to ONEROS, above.	Hydrologic-Soils Models
g. MUSK	Flood simulation program; computes streamflow peaks.	Hydrologic Models
h. DWNSTR	Allocates water to downstream uses when supply is limited.	Priority Ranking Equation
i. RATER	Model of state-discharge relationship.	Special Purpose Regression
j. HYDRA	Calculates stream discharge rates over time and total runoff.	Hydrologic Models
k. DEBRIS	Computes volumes of sediment deposited in channel.	Hydrologic Models
4. Display and Statistical Analysis Tools	General statistical routines, data management programs, and tabular and graphic display packages.	Miscellaneous Group of Programs
5. Resource Allocation Analysis Package	Assists in formulation and evaluation of multiple resource allocation problems.	Linear Programming
D. Roading Timber RAM (Resource Allocation Method)	Finds the combination of timber management activities and road construction activities that maximize net revenue (value of timber hauled, minus costs of timber management, logging, hauling, road construction and road maintenance.)	Mixed Integer Program
E. MULTIPLOY	Assists in formulation and evaluation of forestry investments and management regimes for forest tracts or stands.	Simulation Language

Table 3. AN OUTLINE OF SOME OF THE EXISTING TRANSPORTATION PLANNING SYSTEMS.

A. Recreation Models	Allocate traffic to links in transportation network.	
1. Macro-Allocation Model	Predicts travel behavior from large population centers to major forest areas.	
a. Macro-Generation Model	Estimates aggregate quantity of recreation trips that emanate from population center origins.	Regression Model
b. Macro-Distribution Model	Distributes flow of recreationists from origins to destinations across impedence components (transportation links).	Systems Model
c. Macro-Attraction Model	Reduces a large number of characteristics of a forest into a single index of attractiveness.	Factor Analysis
2. Micro-Allocation Model	Predicts travel behavior within an individual forest or study area.	
a. Micro-Generation Model	Estimates aggregate quantity of trips made by population located within the study area forest.	Cross Classification Analysis of Variance
b. Micro-Distribution Models	Assign trips to links; distribute trips to destinations.	
i. Impedence-Dependent Opportunity Model	Calculates probabilities of trips stopped at destinations based on relative proximity to trips' origin.	Maximum Likelihood Estimation
ii. Simple Proportional	Assumes that number of trips to each destination is proportional to that destinations' attractiveness.	
iii. Touring Travel Model	Estimates traffic flow on links for trips that have no well defined destinations.	Linear Programming
c. Micro-Attraction Model	Develops a single index of attractiveness for each attractor within a forest.	Factor Analysis
B. Timber Transport Model	Assists in computing timber traffic, hauling costs, distances, and time; assists in selecting routes to be used, investments in transportation networks, and timber harvest patterns.	
1. Phase I Sub-model	Considering one transportation-network-timber-harvest-pattern at a time, it generates and evaluates a number of "best" routes between each timber sale node and mill nodes.	Minimum Path Algorithm
2. Phase II Sub-model	Finds the least cost combination of investment in projects (construction and maintenance costs) and haul routes (operating costs).	Mixed Integer Program
3. Phase III Sub-model	Maximizes the total value of harvested timber minus the associated project investment and haul costs.	Mixed Integer Program

Table 3 (Continued).

C. Administrative Travel Model	Selects the most efficient routes and schedule for accomplishing tasks during a number of fixed working days.	Integer Programming Algorithm
D. Fire Protection Model	Finds best location for fire stations on a forest transportation network.	Mathematical Programming
E. Link Analysis Techniques	Focus on a single section of road at a time as opposed to the network analysis techniques described above.	
1. One-lane Road Simulator	Relates link design factors to average speed, travel time, delay and operating cost under congested conditions.	Computer Simulation Model
2. Vehicle Operating Cost Model	Assists in selecting a road design that balances initial construction cost against future operating and maintenance costs.	Computer Model
3. Road Investment Strategy Model	Assists in selecting strategies for construction and maintenance investments in relation to vehicle operating cost and road wear.	
4. Allocating Road Maintenance Funds	Allocates men, money and machines to road maintenance.	Mathematical Programming
5. RDS (Road Design System)	Converts field survey notes and design requirements into information needed to lay out precise road location and to develop construction plans.	Large Number of Related Computational Routines
6. OPTLOC (Optimal Road Location)	Optimizes road location, given origin, destination and other constraints.	Dynamic Programming
F. Transportation Analysis Support Techniques		
1. Transportation Information Systems (TIS) and Road Inventories (TIS-Roads)	This is a system that describes the physical characteristics and geometry of a system of roads and trails using a mathematical model of the transportation network.	Computer Programs and Related Procedures
2. Traffic Surveillance Program	Assists in traffic data gathering, management and statistical analysis.	Handbook and Computer Programs
3. Recreation Interview Survey Data Management System	Assists in gathering information on recreationist travel behavior.	Computer Programs and Related Procedures
4. Decision Making Primer	Techniques for making decisions under uncertainty.	Handbook

METHODS FOR EVALUATING INPUTS AND OUTPUTS

Land use and transportation planning systems cannot be applied without some information on the costs and the benefits of system inputs and outputs. Economists have struggled for years to develop good systems for evaluating quantifiable and priceable factor inputs and outputs; yet, their studies still conclude with the remark that "more conceptual and empirical work needs to be done."

Some current research is devoted to quantifying nonpriceable factors that were formerly nonquantifiable--for example, the method for measuring scenic beauty by Daniel and Boster (1975). However, more work needs to be done in this area, too.

Some factors can neither be priced nor quantified. Methods for evaluating land use and access alternatives in terms of nonpriceable and nonquantifiable factors should also be developed. Factor profile analysis (Oglesby, Bishop, and Willeke, 1970) is one technique that might be adapted for this purpose.

RESOURCE RELATED ADMINISTRATIVE SYSTEMS

In addition to cataloguing natural resource planning systems, Row and Schmelling also identified a number of administrative systems which should be closely coordinated with resource planning. These systems include all the program, budget, and reporting systems, personnel and fiscal management systems, and other planning and control systems involved with the operational phases of resource management. For example, in timber management, these include the

1. Timber Sale Accounting System
2. Timber Statistics
3. Timber Sale Accomplishment and Allowable Cut
4. Timber Management and Control Report
5. Quarterly Report of Timber Cut and Sold, and
6. Regional Annual Reforestation and Stand Improvement Report.

A good example of an administrative system is the set of computer programs called "DyAM", for Dynamic Activity Management, that is currently being developed. The system has been described by Carder and Oglesby (1973, p. 202):

> Where implemented, it would provide estimates of resources (funds and personnel) needed to carry out planned work programs, and it would automatically display comparisons of resources needed and resources available. It would provide means to aggregate and disaggregate programs, projects, and activities into packages suitable for dialogue and decision making at different levels. And it would give managers at every level the capability to continually track and directly compare actual progress with that planned, to pinpoint potential problems, and to determine the needed level of manpower or funds. This would be done by project, by program, by function, by division, or other criterion so that schedules or resource allocations can be adjusted in a timely manner.

DyAM is an administrative system that is intended to be a part of a feedback control model for planning and decision making on national forests. This system is called the ABC Depiction System since it provides decision makers information on Actions, Budgets and Controls (Suhr, 1973).

Just as various natural resource planning systems can be linked together to form land use and transportation planning systems, natural resource planning systems and resource related administrative systems can be linked together to form a unified planning and decision-making system for National Forest management. The Feedback Control Model in Figure 2 illustrates the major linkages required.

CURRENT NATIONAL FOREST MANAGEMENT SYSTEMS DEVELOPMENT PROBLEMS

The Forest Service has identified the following systems development and implementation problem areas (Carder and Oglesby, 1973, p. 61-62):

> Almost all functional divisions and many field units have been sponsoring the development of computer-based models and computer-aided systems for a variety of purposes. Some have been partially implemented and have proven to be quite helpful. But as things now stand, these various innovative efforts are still widely fragmented, with each functional division and administrative unit independently charting and pursuing its own course in this area.

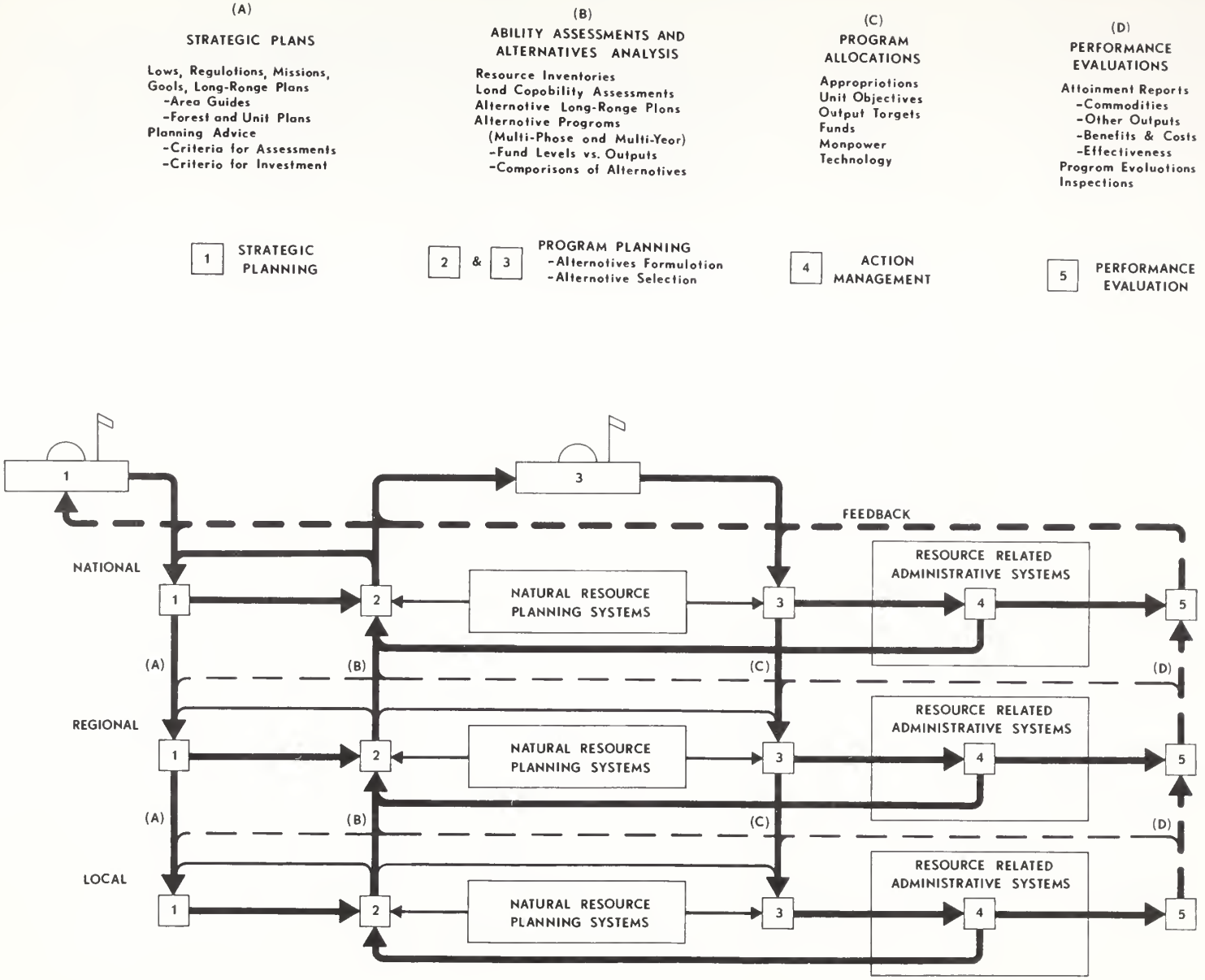

Figure 2.-- A FEEDBACK-CONTROL MODEL FOR FOREST SERVICE MANAGEMENT (THE FRAMEWORK)

New system development efforts continue to be initiated by many groups and on many fronts with no mechanism for learning about them, for coordinating them with related ongoing efforts elsewhere.

Duplications of effort are in evidence, both in developing new systems and in collecting data for using them. There is no procedure for evaluating their relative potential merits or for deciding which merit accelerated development and implementation and which efforts should be terminated or redirected.

For some applications, the intended user is faced often now with an array of alternative new tools and techniques without a satisfactory basis for choosing among them, and often lacking some of the means for implementing any of them.

Too little attention is devoted to problems of implementing a new tool or technique once it is developed. Service-wide implementation is often attempted without fully assessing the impact on local managers, the need for training, and the wide diversity in management conditions and needs among different areas.

Many individuals and groups throughout the organization, recognizing the need, have developed their ideas into tools and techniques intended to assist with multiobjective, multifunctional, multiyear problem solving, but find themselves frustrated as they can find no framework or machinery to push implementation of the fruits of their labor.

CURRENT APPROACHES TO SYSTEMS DEVELOPMENT PROBLEMS

Several different approaches to addressing the systems development concerns of Forest Service managers are currently in progress. A few of the studies that should help define the "sideboards" of future avenues of research, development and implementation will be identified in the following paragraphs.

Management Sciences Staff Analyses

The Management Sciences Staff of the Forest Service is currently examining existing computer support systems for planning. Their first interim report (MaSS, 1974a, p. 1-2) states that the study objectives are to determine:

1. The types of planning situations for which existing systems are to be used.
2. The utility of these systems.
3. The applicability and transferability of these systems to a variety of locations.
4. The gaps wherein no computer support systems for planning exist or are being developed, and priorities for closing the gaps.
5. The criteria for managing systems development including alternative strategies for implementing systems and requirements for training users.

Systems for Interfacing Systems

A strong effort is currently underway to develop systems for interfacing systems. The idea is to create a standardized set of compatible component systems that could be used individually, interchangeably, or in combination with each other, depending on the needs of forest users.

The software core for the consolidated, integrated, standardized set of systems includes, among other systems,

1. the Forest Service Generalized Information Management System (FS-GIM) for communicating numeric and textual information through user oriented statements,
2. the Geographic Locator System (GELO) for managing mappable information, and
3. the Self Generating Master System (SELGEM) that all forest users can utilize for gaining information on all systems accessible to them through a central computer center.

Systems for Encouraging the Use of Systems

Several studies are examining the problem of how existing and developing systems can be fit into the culture, and planning and decision-making environment of the Forest Service. The Lingwood and Morris

CRUSK Study of the Forest Service Research Branch (1975) describes the research and development environment of the Forest Service, and the flow and use of knowledge that it produces. The Lundeen and Dyrland "Proposal for Accelerating the Use of Analytical Techniques for Land Use Planning in the Forest Service" (1974) contains some conceptual ideas on operational needs, such as training strategies and organizational staff requirements, for applying analytical tools to the land use planning problem. Deterline Associates' Design for the Transfer of Technical Information (1974) presents strategies for securing increased use of newly developed, technologically advanced systems.

CRITERIA FOR EVALUATING SYSTEMS

The Management Sciences Staff has noted that (MaSS, 1974b, p.5):

> It is unfortunately not possible to structure a complete decision table by which a Forest Supervisor could correlate the characteristics of his forest and organization with model features and characteristics so that at the end of a number of check points, the most suitable model would emerge as is done, for example, in a plant identification encyclopaedia. The biological, economic, administrative, and social dimensions of a forest cannot be sufficiently structured for such a decision table.

Nevertheless, developers and users of natural resource planning systems should be aware of current thinking on relevant criteria for evaluating systems. These criteria can be divided into two groups. First, there are the traditional criteria that systems analysts deem important from a strict systems point of view (see Table 4 for examples). Second, there is the emerging set of criteria that appears to reflect the current needs of systems users (see Table 5 for examples). But to effectively employ such criteria in guiding future systems development and interfacing will require some rather extensive systems testing and evaluation work. This will be necessary in order to make such criteria operative. Currently, no administrative machinery has been identified within the Forest Service that appears to be well suited for directing or coordinating such work. However, while it may be expensive, it almost certainly will be far less expensive than to do otherwise.

Table 4. SOME TRADITIONAL CRITERIA FOR EVALUATING SYSTEMS

1. What is the purpose of the system?
2. What does it do?
3. What information does it produce?
4. How well does it perform?
   (a) Is it accurate?
   (b) Is it consistent?
   (c) Can these be measured?
5. How much uncertainty is attached to the use of the system?
6. How does the system compare with other systems?
7. Is past research adequately documented?
8. What are its input requirements?
9. Can input requirements be satisfied by available data?
10. How valid is the criterion used by the system?
11. How does the system handle other criteria?
12. What is taken as "given" by the system?
13. Has the system been adequately tested?
14. Is it valid from a theoretical point of view?

SUMMARY AND CONCLUSIONS

This paper has described the development of land use planning and transportation planning systems for National Forest management.

The main points that have been made in this presentation of the state-of-the-art include the following:

1. The complexity and magnitude of the natural resources planning problem necessitates a systematic approach to planning and decision making.

2. Land use planning and transportation planning must be conducted simultaneously within the context of natural resources planning.

3. Unified Planning and Decision making provides a single frame of reference for the designers of systems.

4. The primary focus of attention in the development of systems has shifted from creating new systems to making existing systems fully operational and available for widespread use.

5. For this reason, an examination of existing systems is necessary.

Table 5. ADDITIONAL CRITERIA FOR EVALUATING FOREST SYSTEMS

1. If the decision were made to implement the system, what would be required in the way of funds, personnel, equipment, technical assistance, training and information?

2. Is the system consistent with the Unified Planning and Decision making concepts and compatible with the evolving "Model for Forest Service Management" (Figure 2) and process for management of National Forests?

    (a) At what stage in the process is this system applicable?
    (b) What informational needs does the system satisfy at this stage?

3. How compatible is this system with other natural resource planning systems and resource related administrative systems?

    (a) Are there discontinuities in form, format, units, scale and precision between this system and other systems?
    (b) Does the new system fill in major gaps in the informational coverage of existing systems?
    (c) Do overlaps in coverage between this system and existing systems require unnecessary, costly duplications of effort in keeping all systems current?

4. How easy is it to add data items to, or manipulate data within, the system?

5. How easily can forest managers and users and other interest groups comprehend the system, and the system's results?

6. How much did (or will) the system cost to develop and implement?

7. How cost-effective is the system?

8. Did the developer use existing forest management systems as a point of departure for developing this system?

9. Did forest managers and other potential system users have input into the development of this system?

10. Has the system been tested in a real forest environment; if so, what are the results?

11. Can potential system users trust the system?

    (a) Is human intervention and control possible?
    (b) Is the system being forced on the user by outsiders?
    (c) What would be the political impacts of "overriding" the system with the user's own decision?
    (d) How can system outputs be blended with non-quantifiable information to fit into the final decision process?

12. Does the system require maintenance; must it constantly be updated?

13. Is the system applicable to only one specific type of situation (geographical region, functional problem, etc.)?

14. What improvements are necessary or desirable before the system can be used?

15. What questions remain to be answered before the system can be evaluated properly?

6. This examination has revealed that land use planning systems and transportation planning systems are subsets as well as aggregates of five categories of existing natural resource planning systems:

   (a) Information Collection and Analysis Systems,
   (b) Data Storage, Retrieval and Display Systems,
   (c) Resource Response Simulation Systems,
   (d) Facility Design and Operation Planning Systems, and
   (e) Multiple-Use and Environmental Planning and Decision Systems.

7. Some necessary and potential linkages between existing natural resource planning systems have been described.

8. Better methods are needed for evaluating land use and access alternatives in terms of nonpriceable and nonquantifiable factors.

9. Some necessary interfaces between natural resource planning systems and resource related administrative systems have also been depicted.

10. Some current systems development problems and solutions have been pointed out.

11. A number of criteria for evaluating systems have been identified.

12. Administrative machinery is needed in order to effectively employ such criteria in directing and coordinating future systems development and applications work.

This brief overview of the development of land use planning and transportation planning systems for National Forest management should be a useful point of departure for potential future researchers, developers, teachers, and users of such systems. Interested readers are encouraged to explore the subject further by examining the references in the LITERATURE CITED section of this paper.

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Transportation System Planning for Wildland Areas[1]

Charles L. Burford and Tom W. Jones, III[2/]

Abstract.--The drastic increase in visitation to wildland recreation areas, which began in the sixties and continues today, has challenged the Forest Service to seek ways to make more wildland areas available to the public while preventing deterioration of such areas. This paper reprots the investigation of possible applications of mass/public transportation systems in wildland areas.

INTRODUCTION

Concern for the safe, efficient, and least environmentally damaging movement of people through a variety of wildland recreational areas has been a concern of resource planners and managers for many years. The early road systems in the first national parks, which were constructed prior to the widespread availability of the private automobiles, were designed for stage coaches and motor buses.

With the drastic increase in visitation to wildland recreation areas, which began in the early sixties and continues today, it became apparent to resource managers that comprehensive transportation planning was needed and that a search for ways to reduce the impact of the large numbers of automobiles which were filling wildland recreational areas was necessary. Urban planners recognized the necessity of initiating work on various forms of mass conveyance systems. Increasing concerns over levels of air and noise pollution as well as a greater public awareness of the many negative aesthetic aspects of highway construction resulted in the passage of a wide range of federal and state legislation to lessen environmental stress and provide a higher quality visitor experience. Many of these new experiences in transportation planning and visitor conveyance are discussed in this report.

The National Forests are similar to the National Parks and other wildland recreation areas in many respects. The differences, however, present major, but certainly not insurmountable, challenges to forest land resource planners and managers.

Management of the National Forests involves a host of resource activities which include the harvesting and cultivation of renewable resources. Outdoor recreation and aesthetics are both products derived from the sustained yield management of forest resources. The forest transportation system is not similar to the normal park circulation system, simply responding to a single purpose type of use. National forests are not restricted access areas as are parks. Thus their road linkages are open rather than closed or limited systems. The conversion of these links to limited vehicle use is more difficult than in parks because of the range of vehicles required to transport the products of the forest to market.

National forests are extremely diverse resource areas. Many have unique areas and aesthetic qualities that parallel or surpass some of those found in park reservations. Hence, they are extremely popular recreational areas and attract large numbers of visitors. Problems of crowding, traffic conjestion, noise, environmental stress, and declining quality of the recreational experience confront forest land managers in areas of heavy use. At one time the pressure was for more and larger road systems. Today it appears that recreational users of forest areas are

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beginning to press for solutions to transportation problems which are less violent in terms of their environmental impact, even though this may require modifications in travel mode and recreational life style.

The Problem

The Forest Service, like the Park Service and other managing agencies who have witnessed the burgeoning influx of private automobiles in recreational areas, has become concerned with developing appropriate management strategies to deal with the problem. Rather than to continue to build more roads into heretofore inaccessible areas and enlarge existing roadways to accommodate more traffic generated by growing recreational developments such as the winter sports complexes, the Forest Service has begun to look for new solutions. In addition to problems associated with the tremendous number of vehicles found within some forest areas a host of related problems are associated with the use of private automobiles as the principal mode of conveyance. These include:

*Visual blight created by the indiscriminate location and construction of forest highways;

*Hydrologic imbalance resulting from disruption of natural drainage patterns;

*Eminent danger to forest wildlife particularly where a high volume artery bisects a major migration route;

*Noise and air pollution which detract from the quality of the recreational experience as well as impace on plant and animal life; and

*Forest sprawl of campgrounds and other recreational developments in areas where they are under-utilized and expensive to maintain.

Notwithstanding the Bureau of Outdoor Recreation's (1) finding that driving for pleasure represents one of the most popular forms of outdoor recreation, it has become quite obvious that trends in transportation planning suggest, that in certain instances alternative modes have the potential of being more desirable, feasible, and gratifying the private automobile. This study responds to that recognition.

The Study

The purpose of this study is to identify, investigate, and evaluate the economic, environmental, and social implications of those technically feasible mass conveyance systems which could be utilized as a means of solving specific visitor conveyance problems at recreational developments in forest wildland areas.

Recreation and Transportation

Outdoor recreation, particularly, that which takes place on state and federal controlled public lands is dependant on transportation, because the recreational base is usually located some distance from the participant's residence. The National Recreation Access Study of 1974 (2) states that an estimated ninety to ninety-five percent of all person - trips to significant outdoor recreational areas are made in private vehicles. Significant outdoor recreational areas were defined as those which have 100,000 or more visitors per year, and the majority of these were found to have poor to non-existant public transportation service. (2)

Other studies (1, 3) have indicated that driving for pleasure appears to be the most popular form of outdoor recreation, and that as much as 18 percent of all trips made in this country (accounting for 34 percent of all vehicle mileage) have social or recreational purposes.

United States Forest Service Transportation Planning

The United States Forest Service, as an example of a major governmental land management agency, operates under the concept of multiple use. The Multiple Use-Sustained Yield Act of 1960 Title 16 United States Code, (Section 528-531), enumerates the purposes of National Forest Administration as "outdoor recreation, range, timber, watershed, and wildlife and fish purposes."

Initially, trails were the only means of access to the Forest Reserves established in the 1890's. These trails gradually gave way to roads, often located along the same route, that would accommodate wheeled vehicles for fire protection activities. In the mid-thirties many roads were built in the National Forests by the Civilian Conservation Corps to facilitate a wide range of activities. The mid-fifties gave rise to roads planned, and identified in terms of their primary use of function, such as for timber management. This approach proved to be unsatisfactory because of the difficulty encountered in recognition of and planning for transportation facility influences on resource use. (4)

Since the sixties, the Forest Service has recognized the importance of improving its comprehensive planning process in order to more effectively respond to the growing and changing demands the public exerts on the

resources under their administration. Increased public interest in the environment and the higher values the public now places on its various elements has forced the Forest Service to develop analytical tools and processes to deal with the planning complexities now encountered. (4)

In response to these kinds of concerns and sensitivities the Transportation System Planning Project (TSPP) was established by the Forest Service in 1965. TSPP has concentrated on developing, testing, and reviewing methodologies needed to predict the consequences of alternative transportation plans which are influenced by the quality and cost of varying modes. (5) The analysis tools and processes TSPP is developing will be useful for all modes of transportation, but initial emphasis has been placed on the road transportation mode, because of its present dominance as a means of access to National Forests. A new forest road constructed for access to some part of a National Forest will serve several purposes. Most forest roads constructed to improve fire protection may also serve to ease timber removal, open camping and scenic driving opportunities, and facilitate improved cattle grazing practices. This multifunctional, multipurpose approach to transportation system use in the National Forest complicates forest road planning and economic analysis of proposals. Several problems are encountered, "...foremost among these is the problem of evaluating the aggregate benefit to be derived from the project" and "...a second problem arising from multiple purpose projects is the possibility for conflict of interest between the purposes." (5) A road built for timber harvesting can later be used for fire protection and recreational use if it is planned properly. The cost of the road can be charged to the benefits derived from all uses, if these can be quantified. Because of the standardization of wheeled vehicles, the one road can accommodate logging trucks, fire trucks, private automobiles and other recreational vehicles. With certain limitations on road grade, width, and curve radius, the road can be used by all wheeled vehicles regardless of the planned short-range use.

Economic Evaluation of Alternatives to the Private Automobile

Using the assumption that improvement of wildland recreational transportation necessities a shift from almost exclusive reliance on the private automobile to some alternative, economic evaluation of alternatives becomes very important. There are existing methodologies for cost evaluation of some modifications within the system. (6) For example, the computer systems developed by the Forest Service's Transportation Analysis Group (TAG) to apply analytical techniques and planning systems to transportation planning. TAG has also developed and used Analysis Systems which aid in displaying alternatives and differences among alternatives; and Data Systems that provide basic information needed in formulation and evaluation of alternatives are being developed, tested and used. (6) The work done by TAG is directed towards the existing specialized planning problems encountered within existing transportation technology application.

Although various researchers in recreational transportation analysis have made considerable progress towards analysis of recreational transportation, the techniques for forecasting recreation travel are in their infancy. (2) To arrive at some method of evaluating the costs of alternative transportation systems requires careful analysis of the individual problem. There are two initial categories into which these problems can be placed. These are: 1. Development of some form of access into an area that does not presently have a circulation system; 2. A change from the existing transportation system to one with different modal characteristics.

An example of the first category is the proposed circulation system for Guadalupe Mountains National Park, Texas. This 76,468 acre National Park which was established in 1972 "is totally lacking in the essentials necessary for public use, ..." (7) Public use of the park has been hampered by lack of vehicle and other access to the fragile natural resources located in the park.

Examples of the second category, that is - a change from one transportation system to another with different characteristics are more common. In many recreation areas there are problems associated with the use of the private automobile that a shift to a different transportation system would potentially solve. Yosemite National Park is one of the more frequently quoted examples of a switch from one system to another with better characteristics.

Problem Formulation

If public transportation of people in a wildland setting truly is the solution, the planners must formulate and state the problem. In an address to the American Automobile

Association, Joseph McKenna called rapid transit a solution in search of a problem. (8) Speaking primarily about subway system, McKenna stated that most American cities have none of the conditions necessary to justify mass transit systems, these conditions being high density work, high density residency, and clearly defined corridors between the two. Going even further, he stated that public transit would not turn people away from using private automobiles because it is slower and more expensive. If subways don't turn people away from private automobiles then subways will not reduce pollutions or reduce the acreage in pavement.

In a wildland setting the problem is much more difficult to formulate. The three conditions McKenna used for urban transit justification do not apply, and specific problem areas such as pollution and paving of the landscape are not the primary issues. Wildland planners have been presented with somewhat more ambitious statements of the problem such as "too many cars," "degredation of aesthetic quality" and so on. Wildland managers are charged with protecting the environment so that the public can derive numerous benefits from it. The environment cannot be protected in a pristine condition and be accessable too, without massive economic expenditures and considerable opportunity costs to society.

SYNTHESIS - THE LINK-VEHICLE CONCEPT

Wildland transportation planning is usually done by the agency which is responsible for the resource base. More often than not the planning effort has been suggested or brought about by some individual or group that is concerned with one aspect of the existing or proposed system. Identification of potential users has been mentioned as an important element of the planning process. To expand this approach, once the users or beneficiaries of the system have been identified, their transportation goals and objectives should be identified.

Group Identification

Initially, all transportation systems on public land affect and impact on a minimum of four different groups of people. The groups can be independently categorized as recognized that a person may fit into each category, for the sake of simplicity the following categories may be identified: Operator, Administrator, User, and Non-User.

The operator category is composed of the group of people directly responsible for the system, this group is the one concerned with maintenance, operational safety, law enforcement, and so on. The user category is the group of people who actually depend upon the system for transportation. This group may be broken into sub-groups to properly weight their different transportation values for different travel related activities. The non-user is a category to charactorize the "public" who do not actually utilize the system, but pay taxes and are concerned with the resource. The administrator category is defined as the group that is ultimately responsible for the system. This group is the one which must be held accountable, and who operate within the political frame of public land administration.

Goals and Objectives

Transportation goals and their corresponding objectives can be identified for each group for each transportation system.

In most existing wildland transportation system wildland managers provide the road, route, path or link on which area user supplied vehicles operate. The links or routes may be planned or they may have evolved from some activity such as timber harvesting. The links or routes may be high standard well maintained highways or they may be nothing but a pair of tracks that people travel in pursuit of a recreational experience.

The primary user of these routes are the people who are operating their privately owned vehicles. The vehicles can be classified as having some number of rubber tires that support and power the vehicles. The vehicles for the most part are multiple use, although there are some highly specialized vehicles designed to meet special user/owner needs. The important concept about these vehicles is that the purchase and operating costs are the responsibility of the operator, and they are used to transport the area user from his residence, with his belongings (which may include a number of recreational vehicles) to the wildland area.

The existing situation in most wildland areas is that some number of users arrive at the area boundaries in their vehicles and continue on until they reach the point at which they choose to stop. (Some users may only be traveling through the area and may not stop.) The point at which the users stop may be entirely their own choice, an area in proximity to something they wish to see, or a place they wish to stay in for several days. Most wildland users also have the choice of stopping where others stop, or at an isolated place where they can enjoy the solitude of nature interrupted only by their presence.

The problem is that there are too many of these users competing for the limited spacial resource. Part of this problem stems from the spacial requirements of the vehicles for parking and operation.

Link-Vehicle Concept

Utilization of link-vehicle categorization method can identify the existing system in a perspective that can yield certain assumptions for planning and selection (of modification) of the system within the range of options available.

(1) A "link" will be thought of as the route or path used to get from one point to the other.

(2) A "not supplied link" is the route used by the public moving about in the recreational area.

(3) A "supplied link" is the established road, trail, track or path recognizable to the public as the route to be used in getting from one point to another.

(4) The "line not supplied, vehicle not supplied" (LNVN) classification would apply to the recreationist who is on his own to travel into an unmarked area.

(5) "Link not supplied, vehicle supplied" (LNVS) classification would be applicable primarily when a concessionaire provides a vehicle (including snow shoes cross-country skies, trail bikes, etc.) to the recreationist who uses it for "Off road" travel.

(6) "Link supplied, vehicle not supplied (LSVN) this is the classification that fits most existing situations.

(7) The "link supplied, vehicle supplied" (LSVS) classification would be applicable when both the node and the route are provided to the individual or passenger. Most of the mass transportation systems would fit this category.

The link-vehicle classification concept may be an important method of analyzing transportation alternatives. The "Link Node" network concept has been used for network analysis to determine shortest routes for areas where there is more than one possible access route. Simply stated the existing link-node concept is used for analysis of existing network options. The link-vehicle concept would be used to classify options whereby analysis of the classification would indirectly yield comparative data.

Obvious comparisons can be made immediately. Economically the options can be ordered from least to most expensive: (1) link provided, vehicle not provided to (2) link provided, vehicle provided. Environmentally the options may be reversed when speaking of degradation.

Alternatives to the Automobile

The old question of "which came first: the chicken or the egg" seems to be quite parallel to the question facing wildland area managers in general and the National Park Service in particular: "What is the problem: too many people or too many cars?"

George B. Hartzog, Jr., (9) former Director of the National Park Service, responded to the problem of overcrowding in the parks was not yet at the critical stage. Mr. Hartzog clarified this statement by saying that in some parks, the overwhelming amount of paraphenalia that people bring with them, including automobiles, compers and so on is becoming a critical concern. Instead of limiting the number of people allowed in parks the approach would be to limit automobile use, and provide alternative transportation means.

Mode Selection Problems

Alternative transportation mode selection is an extremely complex problem because of the infinite number of alternatives available to the decision maker. There is a limited number of general mode types available when all modes are categorized by some characteristic, whether it be the type propulsion system used, the type activity the mode is usable for, or so on. Within each category there are secondary characteristics that can complicate the selection process even further.

There are few instances in the modern world where initial cost does not enter into the selection of a transportation system for a particular use. The decision making process probably begins with an unconcious elimination of ideas that seem completely without potential. The rational for this statement is that planners will eliminate or not even think of alternatives that are absurd, and channel their efforts towards evaluation of only feasible alternatives. With existing transportation technology the planner must first state some type of problem

that needs a solution and then eliminate certain types of solutions. In most planning situations there is, at some point, the constraint of cost, among others. There will always be a finite amount of money that can be spent to reach the final solution. Therefore, one approach to transportation mode selection would be the initial categorization of alternatives by their expected cost range. Under this category, there would be subcategories to be used in narrowing the list down to a limited number of system types that could be used to solve the existing problem.

The primary problem with this methodology is assigning the cost range to the individual modes or mode types that will accurately reflect the total system costs under different application situations. Most transportation systems reach their optimum performance level when they have been selected for the specific application. Another approach to mode selection would be to initially categorize alternatives by range of their potential success in meeting application classification, then utilize subclassifications to narrow the selection to specific mode types that have potential for problem solution with or without modifications. It is important to the selection process that alternatives be stated and then evaluated. Without some type listing of alternatives at a point in the process the optimum selection is inherently doomed. The decision-maker must have some type of evaluation of existing alternatives available either to him or to the consultant who is charged with the custom design of a system to meet the stated need. Using this approach to justify the need of some type of presentation of existing alternatives, it must also be made clear that no listing can accurately present all alternatives available within any type of categorization. The continued development and improvement of various transportation mode concepts will outdate any type listing.

PRINCIPAL FINDINGS OF THIS STUDY

This study has revealed the following factors which will affect the implementation of mass/public wildland transportation systems:

1. Interest in transportation planning for the development of workable solutions to the problem of minimizing the environmental impact of moving large numbers of people through wildland areas appears widespread among federal and state land managing agencies.

2. Development of transportation technology and hardware for mass conveyance systems is extensive and involves many of the large diversified aerospace firms such as Ling-Tempco Vought, Boeing Aircraft, General Dynamics, and Lockheed Aircraft.

3. Much of the transportation planning and hardware development which has come out of the search for solutions to urban traffic problems is not easily adaptable to the unique problems and situations encountered in wildland resource areas without substantial modification.

4. To be effective most mass conveyance systems require high volumes of riders traveling along routes where key facilities are clustered, and where competing modes are either restricted or eliminated.

5. Wildland recreational area transportation requirements may fluctuate seasonally while alternatives to the private automobile require stable year round volumes to be economically justifiable.

6. Existing wildland road networks (links) have been developed at a considerable economic and environmental cost. This makes those alternatives that can operate on existing links more attractive than those requiring special right of ways.

7. There appears to be a decrease in the user's clamor for more roads throughout the national forests. Attempts to construct highways through national forests in recent years have met bitter citizen resistance often culminating in lengthy litigation.

8. Most heavily used recreational sites are the most appropriate areas to consider the switch to total or limited reliance on mass conveyance. Many such areas are usually major attractions which draw visitors on a year-round basis.

9. The more exotic forms of mass conveyance, such as tramways, automated people movers, and similar systems, while creating minimal environmental impact, are very expensive to install and operate. These are not considered feasible solutions in most instances.

10. A forest circulation system, for the most part, must be a multiple use system capable of moving people and resources. Only in specific single purpose situations can an exclusively recreational conveyance system be considered.

11. The circulation system is a major factor influencing land conversion and management on both public and private land. There appears to be a move to integrate forest transportation planning with local and regional

comprehensive planning.

12. Recreational attractions do not exist in and of themselves. They must be identified, designed, and developed for a specific purpose, owned by a public or private body, and managed at some level. Access to such attractions is a part of this process. The circulation system plays a major role in the comprehensive resource management plan for a forest recreational area. This system can be effectively used to allocate or ration visitation within high impact areas which are extremely fragile.

13. More knowledge concerning the social and psychological factors involved in the shift from exclusive reliance on the private automobile to use of various forms of mass conveyance systems is needed by planners. Previous research dealing with characterizing recreationists and developing socioeconomic profiles of various user groups can be applied to this area of transportation planning.

14. No data has been uncovered which leads us to determine that the end of mass reliance on the private automobile is imminent. Higher fuel costs and even limited availability have only slightly dampened the level of recreational travel in the United States. This does not mean, however, that there is not a very significant role for certain applications of mass conveyance technology to solve existing or prevent future problems of environmental degradation.

CONCLUSIONS

Mass/public transportation systems can be utilized in only very limited situations within National Forests due to the multiple uses--outdoor recreation, range, timber, watershed, and wildlife and fish purposes--expected of National Forests. Additionally, the high-uniform number of users required to sustain mass/public transportation systems are to be found in wildland areas in only limited situations, with extremely few such situations existing in National Forests.

Wildland areas with high day use recreational demands in close proximity to metropolitan areas and areas likely to develop into such are considered likely candidates for mass/public transportation systems and worthy of further transportation related study and planning.

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Procedures for Analyzing Regional Environmental Problems and Opportunities[1]

Raymond J. Supalla[2]/

Abstract.--Three commonly used procedures for analyzing regional environmental problems are evaluated with respect to usefulness for management planning: environmental impact analyses, ecological-economic input-output models and traditional simulation models. It is concluded that each approach has major deficiencies, but that simulation has the most potential to be an effective tool. Suggestions for improving each approach are offered.

INTRODUCTION

In this paper it is assumed, perhaps incorrectly given the institutional realities of modern society, that publicly supported analyses of regional environmental issues should be designed to further the public interest. Although currently popular analytical procedures are usually directed at this objective, it is my belief that they often fail to provide useful results that are consistent with the public interest. My purpose herein is to identify why commonly used procedures often do little to further the public interest and to suggest appropriate modifications.

ROLE OF ANALYSIS

Analysis of regional environmental issues can be considered successful only if they result in improved decisions consistent with the public interest. If this objective is to be met, analytical procedures must efficiently provide outputs that are useful to decision makers and unbiased with respect to political interest groups.

What is useful to decision makers depends, of course, on who is making the decisions. Resource management decisions are made by many different groups, both public and private, but the most powerful and influential decision makers are politicians. Therefore, the usefulness criterion for a good analyses demands that the output of analytical procedures be politically relevant. Politically revelant outputs are those impacts associated with a management alternative which are of concern to politicians. Analysis of politically irrelevant factors will have little impact on resulting management decisions and thus are a waste of research resources. Therefore, the critical question becomes what are the politically relevant variables to consider when analyzing regional environmental management issues.

Politicians are quite rightfully concerned with the distribution of gains and losses associated with management alternatives as well as with the aggregate impacts. This means that the politically relevant variables to consider are all factors which affect human welfare evaluated in terms of who gains and who loses. In other words, the ideal analysis would measure not only aggregate impacts on such quality of life variables as income, employment, aesthetics and public safety, but also measure the distribution of these effects in terms of political interest groups. Politicians must know the distributional effects of alternative policies before they can intelligently invoke the value judgments of society in making the necessary decisions.

The second criterion for a good analysis is that it must be unbiased with respect to political interest groups. An unbiased analysis can be defined as one which does not exclude or deemphasize quality of life variables which are important to some political interest groups but not to others. Unfortunately

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1/ Paper presented at the symposium on Man, Leisure and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

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analyses often focus on particular variables and exclude others for at least three reasons: 1) the analyst emphasizes his area of expertise; 2) the analyst emphasizes variables consistent with his personal preferences: and 3) the tools are better defined for some variables than for others.

The expertise of analysts presents a problem because it is nearly impossible for the individual trained in ecology to give equal weight to economic variables or for the economist to give equal weight to ecological variables. To combat the problem the use of multi-disciplinary study teams is essential.

More serious than bias due to expertise is bias due to personal preferences. People interested in studying regional environmental management problems, be they economists, ecologists, geologists or whatever, generally have preferences distinctly different from those of the population at large. The very motivation for studying regional problems is often an observation that resources are not being used in a manner consistent with their personal preferences. In recent years this phenomenon has been most vividly illustrated by increased environmental concern. The people studying environmental problems are for the most part those people who place a relatively high importance on variables such as air quality, water quality and aesthetics and less importance on economic variables such as income, employment and low-cost timber. This type of bias leads to analyses that have little inpact on decisions because bias destroys the credibility of an analysis or, worse yet, the analyst succeeds in camouflaging his bias and decisions inconsistent with the public interest are rendered.

The third and final criterion for evaluating analytical procedures is that the procedure used should provide the desired outputs as efficiently as possible. Given that the objective of analyses is to evaluate management alternatives, efficiency demands that a study focus on the most feasible alternatives and the differences between them. Analyses of alternatives that have no chance of implementation for legal, political or economic reasons is an exercise in futility. Similarily it is inefficient to consider the impact of feasible alternatives on a given variable if there is no a priori reason to believe that the impacts will be different. If, for example, one knows beforehand that the impact of each alternative on game animal populations will be similar, it would be wasteful to measure the impact because it will have no bearing on the management decision.

CURRENT STATE OF THE ART

Procedures currently used for analyzing regional environmental management alternatives range from writing bureaucratic justification statements to developing complex simulation models. This section briefly evaluates three commonly used approaches, given the criteria discussed above. The three approaches considered are: 1) environmental impact analyses; 2) ecological-economic input-output models; and 3) simulation models.

Environmental Impact Analyses

The National Environmental Policy Act (NEPA) of 1969 requires that environmental impact statements be drafted for federal programs. Environmental statements must include discussions of: 1) the environmental impact of the proposed action; 2) alternatives to the proposed action; 3) any adverse environmental effects which cannot be avoided should the proposal be implemented; 4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and 5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented (NEPA 1969). Environmental impact statements are supposedly written after tentative decisions regarding resource use have been made, but nevertheless it has become increasingly common to use an environmental impact statement approach in evaluating management alternatives. How adequate is such an approach given our established analytical criteria?

Environmental impact statements have usefully served to force consideration of ecological variables that have historically been ignored. But, such statements focus on identifying impacts as opposed to evaluating trade-offs and thus stop short of providing the ideal types of information needed for management decisions. Although alternatives (trade-offs) are considered in environmental impact statements, the alternatives considered are those which relate to reducing adverse environmental impacts as opposed to those which might contribute most to a net gain in human welfare. For example, the law requires that alternative construction practices for reducing soil erosion from a given project be evaluated in depth, but alternatives to the project itself need only be mentioned.

Environmental impact statements essentially identify whether plans for a given program

are ecologically sound as opposed to whether the program is the best feasible use of the resources. Thus, the results of this approach are not very useful to decision makers. Furthermore the emphasis on ecological factors amounts to a bias in favor of political interest groups with unusually high preferences for environmental products. Lastly, environmental impact statements are an extremely inefficient approach because they traditionally include much more detailed data than is necessary for efficient decision making. For example, detailed inventories of vegetation and wildlife are frequently made even when a priori knowledge indicates that the impact on such resources will be negligible. It is indeed clear that analytical procedures which follow an environmental impact statement framework facilitate meeting the requirements of NEPA, but are of questionable value in making resource management decisions.

Ecological-Economic Input-Output Models

Economists have for many years used input-output models to evaluate the impact of policy alternatives on economic variables. More recently, Walter Issard and others have attempted to link ecological and economic systems in an input-output relationship (Issard 1968). The essential elements of this approach are a Leontief inverse of a traditional regional input-output matrix and an environmental matrix containing data on environmental pollutants per dollar of gross output for each sector of the input-output matrix. Implementation of the model is achieved by multiplying the environmental matrix by the Leontief inverse. The results show the cumulative effect on a local environment of changes in area economic structure and provides the basis for estimating the environmental repercussions of different types of economic activity. More specifically, the model is capable of providing results such as, how much air pollution and water pollution would increase if the amount of mining activity in the region were increased by a particular amount.

Knowing how a change in one sector of the economy affects all the other sectors and what impacts such changes have on environmental variables is necessary for analysis of management alternatives. However, knowledge of these relationships alone does not enable one to adequately evaluate management choices. There are three major deficiencies associated with an input-output approach: 1) it does not lend itself very well to considering politically relevant quality of life variables; 2) it takes input-output coefficients as given, as opposed to treating them as variables to be influenced by management alternatives; and 3) it is highly inefficient.

The results of ecological input-output analysis are economic activity and pollution levels. Decision makers are rightfully more interested in variables such as increased incidence of health problems, local tax revenue generated, employment increases by skill levels, effect on wildlife populations, etc. Although more politically relevant results could be produced with input-output models, linearity requirements and data availability preclude much progress in this direction.

The second deficiency is more serious. Many enviromental management issues involve production technology alternatives as opposed to alternative levels of economic activity. For example, the question is often how to produce more vacation homes with minimum impact on recreational values, instead of how much recreation and how many vacation homes to produce. In using an input-output approach, one essentially develops a set of production relationships associated with given management practices and thus, this approach has only limited usefulness for evaluating management alternatives.

The input-output approach tends to be inefficient in the sense that such models are complex and require large amounts of data, but nevertheless yield results that are of only limited usefulness.

The input-output approach does have the advantage of yielding relatively unbiased results. Research resources and data availability are the prime determinants of model structure and therefore personal preferences and skills are less likely to be influential in the selection of variables for analysis.

Traditional Simulation Models

It has been argued that all socio-economic models are simulation, but much of the literature suggests that simulation has certain unique qualities and thus deserves recognition as a separate analytical tool.

A simulation model of an economic system describes how the system operates in an abstract manner that lends itself to the manipulation of parameters in order to assess to consequences of policy alternatives. Construction of simulation models is more of an art than a science, because there is no straightforward method of reducing real world phenomena to abstract terms. Nevertheless, it may be useful to describe some of the less artistic but technical aspects of this type of analytical modeling. Forrester

asserts that system models should have the following characteristics (Forrester 1961):

1. Be able to describe any cause-effect relationship that may be significant.

2. Be simple in mathematical nature.

3. Be closely synonymous in nomenclature to industrial, economic and social terminology.

4. Be extendable to large numbers of variables without exceeding the practical limits of digital computers.

5. Be able to handle "continuous" interactions in the sense that any artificial discontinuities introduced by solution time intervals will not affect the results.

Simulation models which follow Forresters guidelines are very useful analytical tools. The emphasis is on relevant cause effect relationships described as simply as possible, using widely understood terminology, with maximum flexibility for considering alternatives over time. However, resource management systems are extremely complex and thus difficult to model. Both the potential and the difficulties of simulation are clearly portrayed in a Eisenhower Consortium study conducted by Mertes and Carruthers (Mertes, et al, 1973).

Mertes and Carruthers developed a regional resource use schematic for a relatively large West Texas - Eastern New Mexico region. Their schematic outlines the flow of both public and private resources from production through various stages of processing to consumption. Resource allocation is shown to occur through the actions of public resource management agencies and a myraid of decisions within private resource markets. The three general production categories used in the framework are: public production of goods and services (which might include scenery, watershed areas, and wildlife), public-private production involving the use of both public and private resources (energy production, mining, recreation, agriculture and timber are examples of processes using resources from both sectors), and private production.

Public goods and services are shown to be distributed through what is called a quasi-market; a market which may not be entirely responsive to both supply and demand pressures but operates to distribute goods and services according to administrative rules or use regulation. Energy and recreation, the output of public-private production, are sometimes distributed through a quasi-market to final consumers. Some forms of energy, some of the recreational services, and most of the mining, agriculture, and timber products from public lands are marketed either as immediate goods to the private sector production or to final output markets. Private production reaches consumers through output markets which may or may not be regulated by public agencies.

Consumer demand is characterized as being public, private or for export. The level of consumer demand is dependent upon social pressures, tastes and preferences, income levels of individuals within the region, population of the region, and the characteristics of the population of the rest of the world. Provision for regional consumers to elect to import some goods and services from the rest of the world is incorporated in the model.

Regional resource systems are clearly very complex and thus difficult to simulate. Carruthers and Mertes identify eight specific problem areas where simulation is difficult because of current limited understanding. The eight problem areas are:

1. The dynamics of the resource management decision process.

2. Procedures for making political and administrative value judgments (related to number one).

3. Relationships between private production decisions and public investment in public services and infrastructure items.

4. The quasi-market for public goods.

5. Relationship between resource use regulations and the allocation of resources.

6. Conflicts or interactions between the production of different goods and services, e.g., the development of second homes and its impact on recreational values.

7. The relative effectiveness of alternative policies or procedures for implementing management plans.

8. The impact of private resource use regulations on other regions.

The above are some of the more significant problem areas, but the critical question is are they worth solving. In other words, if these problem areas were solved and the system simulated, as described, would the results satisfy the criterion for a good analysis.

Simulation has the potential to provide efficient, useful and unbiased results. It lends itself to considering all relevant outputs, including publicly and privately provided quality of life variables, and the full range of alternatives for achieving desired results. Like environmental impact analyses the possibilities of bias through selection of variables for inclusion is present, but probably to a lesser degree, because omissions are more obvious with an analytical technique that purports to be comprehensive. Perhaps the greatest weakness of simulation is inefficiency due to complexities of model construction and the information deficiencies discussed above.

Although simulation has the potential to be a very adequate tool, it should be pointed out that simulation is subject to many of the same pitfalls which characterize other analytical techniques. Foremost among these is a failure to consider the most politically relevant quality of life variables and inefficiency due to needless complexity. A simulation model can be as simple or complex as the situation demands, but all to often they appear to be designed to serve all possible purposes instead of efficiently focusing on the important management issues.

Suggestions

It is apparent from review of currently popular types of analytical procedures that much methodological work remains to be done. Environmental impact analyses, ecological-economic imput-output models and simulation all are deficient with respect to one or more of the established criteria. Environmental impact analyses which do not go beyond the requirements of the National Environmental Policy Act fail to meet any of the established criteria and thus should not be used as a management tool. Ecological-economic input-output models tend to focus on the wrong variables and have limited flexibility, but may be useful in selected circumstances. Simulation models are difficult to construct and often fail to efficiently provide results which are useful to decision makers, but appear to have the potential to meet a wide range of resource management needs.

Despite the general advantages of simulation models, the most appropriate analytical procedure to use depends on the resource management issues involved, the availability of research resources, and the expertise of the analyst. In selecting the analytical procedure to use and in developing the subsequent model it seems to me that it would be useful to follow two general principles: 1) preceed all analyses with a diagnostic investigation; and 2) emphasize the relationships which illuminate management choices.

It is essential for efficient use of research resources that the first analytical step consist of diagnostic investigation. A suitable diagnostic investigation might involve three elements: 1) interaction with decision makers and political interest groups to identify the quality of life variables which are of concern; 2) interaction with resource management specialists, both public and private, to identify relevant policy issues; and 3) compilation of secondary descriptive resource data to identify management alternatives that may be relevant but unknown to management specialists. Information gained from these processes could then be used to bound the analysis and focus attention on what matters to decision makers and what the choices are. However, one will gain useful information only if the proper questions are asked. Thus, it might be useful to discuss what is meant by "quality of life variables" and "relevant management alternatives."

Relatively casual observation of decision making processes indicates that oftentimes what is most important is who is affected as opposed to what is affected. For example, who uses a recreation area, Texan's or New Mexican's may be more important than how many man-days of skiing are produced. Therefore, it is extremely important that decision makers be queried as to who as well as what.

Relevant management alternatives are the policy choices available to resource managers within the region. They include both direct resource use alternatives, such as how much public land to place in wilderness status, and indirect alternatives such as what type of private land use control policies to adopt.

Analyses which focus on correct quality of life variables and the relevant management alternatives will be most effective if emphasis is given to those relationships which substantially illuminate management choices. Choices are illuminated if and only if the estimated impacts on quality of life variables are different for a given set of alternatives. One should not devote resources to detailed specification of, for example, employment impacts unless there is reason to believe that the employment effects associated with two or more alternatives will be significantly different. Adopting this principle permits one to allocate research resources to those aspects of a resource management system where more information will most likely lead to better decision making.

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Session II Discussion

Session II A

Edwin Clark (response to comment about rural growth): You're all probably aware of the interesting population trends that have been occurring since 1970, where rural population is growing faster than urban, faster than the national growth rate. There is a high correlation between the counties experiencing the largest recreational development and the counties experiencing the largest permanent population increase. A lot of people now getting out of school are willing to take a substantial cut in monetary or non-monetary income to live in a rural environment.

Another factor is that employment is moving out of the cities into the suburbs, following the workers.

Question: Here in Vail, the people seem to be either quite affluent or relatively poor--the workers. Do you see any long-term consequences of this situation?

Clark: It's my understanding that the relatively low-income workers don't live here --they can't afford to. That's one of the problems.

Alan Kneese, UNM: How did you compute the density for your cost-of-sprawl study?

Clark: Most of the conclusions from the cost-of-sprawl study are based on what we call community analysis, which had 10,000 dwelling units on about 3,300 acres.

William Welch, ASU: Is skiing more expensive, in terms of resources, than boating?

Richard Walsh: I'm not certain. If you take all boating--sailing, canoeing, boating with a very small motor--I think you will find that energy consumption is not very large. For yachting, on the other hand, energy consumption must be quite substantial. Not only for construction of the yacht, but its operation and maintenance.

Question: Dr. Held, do you have any information on the income and occupation of the buyers in your study?

Burnell Held: There tended to be generally a heavier representation in the upper income levels. There were a number of professional people and others; as a matter of fact there were a handful of CSU faculty members in that group.

Question: You indicate that people who own land adjacent to public land realize considerable benefit. How about taxing some of this benefit?

Held: I would agree that these properties are probably under-assessed in terms of their real value; this again is a capture of public value by private property. Probably the easiest way would be through more realistic assessment of these properties.

David Chase: A primary problem would be: Who would do the assessing, and who would pick up the revenue? The Forest Service is spending its money to support the subdivisions in our area but I'm sure the property owners wouldn't stand for the Forest Service assessing them. In fact, some of the residents of these properties feel that the Forest Service has a responsibility to police the area to keep people from trespassing on their private property!

James Mertes, Texas Tech: How would you handle the wipe-outs on property evaluation that occur when some of these environmental planning tools substantially depress market values?

Chase: On the western slopes of the San Francisco peaks, near Flagstaff, we've had a very interesting case where the developer has insisted he has some $2\frac{1}{2}$ to 3 million dollars invested in approximately 340 acres of land, for the purpose of a high-density condominium and recreation-type village. There were some very vociferous disagreements on environmental concerns. In the end, the Zoning Commission refused any preliminary zone. It sent the proposals back and said no, there is a 1-year moratorium on development. That moratorium has essentially taken away the private development right. Currently, there is extensive negotiation with the Forest Service on a three-way land exchange program whereby the private land holder would exchange with the State, who in turn would exchange with the Forest Service. A number of other routes have been explore, but in essence, the general public has looked to the public agencies to pay for preventing something they did not want to occur. What we have, in effect, is a re-defining of what a private land owner can do with his land.

Welch: How do you handle the problem of raising taxes drastically for elderly, retired people who have been living a planned, comfortable retirement, but suddenly find themselves "taxed out" of their homes because recreational development has drastically increased their property value?

Loren Potter, UNM: I own property in Minnesota, and am considering changing my residence to Minnesota because they have a law that once you're 65, the taxes are not increased. We're assured of the same taxation rates from age 65 on.

Comment: When I'm 75 years old, I hope to make some sort of a note arrangement with a banker, who will pay my taxes for me at a fair rate. When I die, and the property sells, the banker will be repaid those taxes that he paid. It seems to me that private individuals can handle this problem in a way that it need not always be a social problem.

Section IIB

Raymond Supalla, NMSU: Gordon, you contend, and I tend to agree that it's important that perhaps over time if we stick to permanent housing development, tax revenue may not be sufficient to cover public costs. You also mentioned a comparable multiplier effect associated with people who are becoming permanent residents. It seems to me that when one moves into an area permanently, he is going to induce considerable commercial development. This, of course, will generate additional tax revenue. Would you elaborate on this multiplier effect?

Gordon Lewis: You're right in that additional economic activity will create additional tax revenue to the county. However, in most rural counties, we're talking about a county dependent on the property tax. Most counties have not yet developed a procedure by which they can establish a county sales tax, a county

severance tax, or the others without going through a lengthy voting process, and quite frequently they are voted down. Economic activity that is generated by the permanent residents quite frequently is a great benefit to the State, and some of the feedback on sales taxes and so forth. But the County officials right now are not too enthusiastic about it.

Richard Walsh, CSU: Gordon, you remarked that second-home communities do not require expensive county services. For example, most of the county budget goes for the schools. What about the impact of seasonal workers, specifically construction workers who would be available for repair of roofs and gutters and things like that during the summer season, but who shouldn't be evicted in winter. Wouldn't these seasonal workers who generally tend to be low-paid, be a county problem, in terms of crime and social services and schools for their children?

Lewis: Perhaps, depending on the scale and location of the development. In Gila County, Arizona, where the vacation home developments are fairly well dispersed, you have a gradual growth, not a boom. In the winter, construction slumps off. Some of these people do go on county welfare rolls, but not too many. Up there the pace of life is easier; the maintenance people just work a little harder when the summer people are in, then ease back in the winter.

Question: Mr. Stuart, could you explain a little further about the land exchange situation at Big Sky? In most situations the U.S. Forest Service maintains control of environmental quality of ski runs. What agency monitors environmental quality at Big Sky?

David Stuart: I really don't know how that aspect of land exchanges is handled. Some 11,000 acres of Big Sky is in private ownership, and I imagine the Montana Department of Health and Environmental Sciences is responsible for monitoring water and air quality. I doubt that the Forest Service has any control over what's going on.

Section II C

William Welch, ASU: I'd like to ask Dr. Supalla, or anyone else, if he has seen any models that involve a capability where you can establish goals within the model and then let the model search around for value judgments?

Raymond Supalla: I haven't seen any that do that successfully, in my opinion. People who make the value judgments are ultimately the politicians. Analysts, such as ourselves, cannot list such judgments. All we can do is define the impacts of certain things, in such a fashion, consistent with what is important to people. The decision-makers can then mesh these impacts with the values and goals of their constituency.

Rueben Weisz, U of A: There have been some such systems developed. The latest one is called Goal Programming. I can give you some specific references later.

Peggy Spaw, Ariz. Land Dep.: Is there any common vernacular being developed for the average person who has to work with your findings, or has to testify at a hearing on planning or some environmental issue? We need some common language so we can talk to each other!

Weisz: I mentioned the central core systems the Forest Service is developing. One of them involves developing a language that appears to work like English--to most people. Another system is the "situation room" concept Terry Minger talked about last night.

Question: We've had considerable comment about the apparent illegality of maintaining a list of concerned citizens so that agencies would be able to alert people about environmental issues and get public involvement. Doesn't the National Environmental Policy Act supercede the OMB restrictions and the Invasion of Privacy Act?

John Ostheimer: Evidently not. Even though such laws as the Multiple Use--Sustained Yield Act require public involvement, they do not specifically authorize the collection or retention of information about individuals.

Gordon Lewis, RMFRES: The Invasion of Privacy Act of 1974 comes after NEPA, so therefore this privacy act supercedes anything in NEPA; there is a conflict. We are required to have public participation, but we can only announce meetings and hope that interested people will come. It's illegal to keep lists.

SESSION III

ENVIRONMENTAL CONSEQUENCES OF DISPERSED AND CONCENTRATED DEVELOPMENT, WITH EMPHASIS ON OPPORTUNITIES FOR MITIGATION

Chairman: David B. Thorud, Director
School of Renewable Natural Resources
University of Arizona

A. WATER QUALITY IMPACTS

Coordinator: Loren Potter
Department of Biology
University of New Mexico

B. AIR QUALITY IMPACTS

Coordinator: Robert J. McColloch, Dean
The Graduate School
University of Wyoming

Session III explores the various environmental impacts of concentrated and dispersed developments in fragile environmental areas. Research dealing with approaches to mitigating air and water quality impacts are presented. Speakers explore ecological, engineering, and economic aspects of the problem.

Environmental Consequences of Dispersed and Concentrated Development, with Emphasis on Opportunities for Mitigation[1]

Alfred L. Parker[2] and Allen V. Kneese[3]

Abstract.--This paper indicates the scale of energy development which may occur in the Southwest Region. It further traces the paths by which this energy development will impact the environment including, among others, housing, recreational home development and recreational activities. It identifies issues surrounding dispersed vs concentrated development and suggests some needed policy and institutional changes to resolve them.

Planned and projected energy resource development in the Four Corners Region (now generally defined to include all land within the boundaries of the states of Arizona, Colorado, New Mexico and Utah) and associated population changes threaten to put extreme stress on the regional environment. Since this continued development will occur in highly fragile, arid, semi-arid and alpine ecological systems common to the area, the impact on scenic and environmentally critical areas, including wildlife habitats, fragile slopes, and stream valleys, would, in the absence of effective mitigation measures, be severe.

It is the objective of this paper to examine the nature and scope of the environmental impact of energy related development activity and to identify some positive policies and programs that can help to maintain the environment of the region.

As evidenced by the data recorded in Table 1, the Four Corners Region is a major repository for conventional fuels--oil, gas, coal and uranium. At the same time this region is clearly also a major repository for several unconventional energy sources--oil shale and geothermal. A survey of existing proposals for the development of these energy resources (both conventional and unconventional) clearly suggests their massive potential for both economic development and environmental disruption in the region.

Four Corners Energy Development

The proposed expansion of coal-fired electric power generation for the Four Corners Region is summarized in Table 2. Current plans call for significant expansion in each of the four states through 1990. It should be emphasized that the environmental impact of this expansion program is not limited to direct and secondary effects of plant construction and operation. Nor is the impact limited geographically to the plant site and immediate vicinty. This is evident from the fact that the later phases of the construction program contemplate the establishment of a total of nine new transmission corridors.

While there are no nuclear power plants in the region at present, increased interest in this type of energy is indicated by the U. S. Energy Research and Development Administration report of three units planned for Palo Verde Nuclear Generation Station at Winterburg, Arizona.[4] Units 1, 2 and 3 of this facility

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1/ Paper presented at the symposium on Man, Leisure and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

2/ Alfred L. Parker, Associate Professor of Economics, The University of New Mexico, Albuquerque, New Mexico.

3/ Allen V. Kneese, Professor of Economics, The University of New Mexico, Albuquerque, New Mexico.

4/ U. S. Energy Research and Development Administration, "Nuclear Power Reactors in the United States," March 31, 1975.

TABLE 1

Energy Resources of the Four Corners States

	Arizona		Colorado		New Mexico		Utah	
	1973	1974P/	1973	1974P/	1973	1974P/	1973	1974P/
Coal (bituminous) -- thousand short tons	3,247		6,233	7,095	9,069	8,335	5,500	5,993
Natural Gas -- million cubic feet	125	32	137,725	143,533	1,218,749	1,268,999	42,715	52,865
Natural Gas Liquids:								
Natural Gasoline and cycle products thousand 42 gallon barrels			1,424	1,472	9,848	10,435		
L P Gases -- do			1,978	2,030	29,652	30,102		
Petroleum (crude) -- thousand 42 gallon barrels	804	766	36,590	37,486	100,986	100,010	32,656	40,880
Uranium (recoverable content U_3O_8 -- thousand pounds			1,920	W	9,140	W	1,940	W

P/ Preliminary

W Withheld to avoid disclosing individual company confidential data

Source: "Mineral Industry Surveys", U. S. Department of the Interior, Bureau of Mines

TABLE 2

Coal-Fired Electric Generating Plants
(100 MW and above)
in the Colorado River Basin

(megawatts)

	Phase I*	Phase II± Additions	Phase III+ Additions	Phase IV✓ Additions	Total
Four Corners (NM) 1-2-3	572	-			
Four Corners (NM) 4-5	1,590	-	2,750	1,250	7,583**
San Juan (NM)	489**	932**			
Navajo (Ariz.)	2,310	-	-	-	2,310
Cholla (Ariz.)	-	500	-	-	500
Huntington Canyon Emery County (Utah)	430	430	-	1,000	1,860
Kaiparowitz Plateau (Utah)	-	2,250	4,250	1,750	8,250
NW Colorado	-	900	-	6,000	6,900
Mohave (Nev.)	1,580	-	-	-	1,580
Southern Nevada	-	1,600	-	-	1,600
	6,971**	6,612**	7,000	10,000	30,853**

* Planned to be in-service by 1977.
± Projected to be in-service by 1980.
\+ Potential plant addition to be in-service before 1990.
✓ Plant additions to be in-service by 1990.
** Adjusted to reflect more recent data in Public Service Company of New Mexico "Prospectus" dated March 12, 1975.

Source: Federal Task Force Study Management Team, Southwest Energy Study, Summary Report, 1972.

(each with 1,237.7 megawatts capacity) are scheduled for commercial operation in 1981, 1982 and 1984 respectively.

Delays in the construction of planned coal and gasification plants on the Navajo Reservation near Farmington, New Mexico and announced delays in the construction of oil shale plants to be constructed in northern Colorado and Utah leaves some confusion concerning the development of these energy resources. But rapidly changing technology and/or changes in the prices of alternative fuels is expected to provide the stimulus needed to overcome existing resistance to the development of these energy resources.

Activity related to the development of the regions' geothermal and solar energy potential remains at the experimental stage. Substantial research programs are continuing at major research centers in the Four Corners Region--including Los Alamos Scientific Laboratory and Sandia Laboratories, as well as at a number of universities. The recent ERDA announcement that the experimental solar energy plant will be constructed at a New Mexico site and Los Alamos Scientific Laboratories experimental geothermal-energy system on the Jemez Plateau of north-central New Mexico forecast continuing interest and activity directed toward the development of these unconventional energy sources.

As the general public becomes more fully aware of the reality and significance of the so-called "energy crisis" even greater pressures for the development of the energy resources of the Four Corners Region can be expected. It is not unreasonable to suppose that the abundant resources of coal in the region might eventually become the basis for a massive liquefaction industry as our domestic petroleum resources are depleted. This type of development presupposes planning, policy making, and institutional capabilities in the region which are, for the most part, yet to be developed. We return to this theme at the end of the paper but first let us take a closer look at the type of impacts which may occur.

Economic and Demographic Impacts

An obvious and highly significant impact resulting from the continuing development of Four Corners energy resources will come in the form of economic (income and employment) and social effects. A substantial portion of the region to be most directly impacted is now sparsely populated, with low average incomes per capita and limited employment opportunities. The construction and operation of the planned energy facilities will thus have immediate and highly visible effects of considerable consequences to the residents of the region.

A partial indication of the magnitude and timing of the potential impact may be obtained from data available on specific energy projects. For example, estimates of the economic and social effects of the planned expansion of coal-fired electric power generation as reported in the Southwest Energy Study indicate that during Phases I-IV employment during construction will total 365,440 man years while employment during operation is expected to reach 17,620 average annual man years. The operation of the power facilities is expected to support a population of 50,000.5/

The economic impact of the planned coal gasification development is also extensive--construction would require 3,500 construction workers for each plant at the peak period while basic employment and population figures for the "steady state," after opening at the two central plants, has been estimated at 2,420 and 9,800 respectively.6/

The economic and demographic impact of the development of still other forms of coal energy, of nuclear, geothermal, oil shale, and solar energy resources are similarly expected to be of major importance to the region.

Environmental Impacts

The environmental impact of energy development in the Four Corners Region, much of it a result of the population shifts and economic development just reviewed, is also expected to be significant. Unfortunately information concerning potential environmental impacts is not so readily available, nor are the data so easily quantifiable, as in regard to economic and population growth aspects.

Environmental Impact Statements (EIS) and similar environmental evaluation studies that are available have been prepared in conjunction with specific energy resource development projects. These studies have understandably emphasized the environmental impact resulting from the primary sources of environmental disruption specific to a particular project (construction and operation of plant and equipment, construction of support facilities, transmission line corridors, etc.). Secondary and tertiary environmental impacts resulting from alterations in the economic and demographic characteristics of the region, which may turn out to

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5/ Federal Task Force Study Management Team, Southwest Energy Study, Summary Report, 1972.

6/ Development Research Associates, Housing and Community Services for Coal Gasification Complexes Proposed on the Navajo Nation, April 1974.

be even more important, have largely been ignored or de-emphasized. Analyses of those impacts bearing on the local fish and wildlife populations have been vague, general and qualitative in nature. The following excerpt from the Federal Energy Administration Draft Environmental Impact Statement Energy Independence Act of 1975 and Related Tax Proposals, March, 1975 is typical:7/

> "Alterations on air, water, land and noise levels could affect ecosystems in areas of energy supply development. Wildlife and vegetation would be directly affected by land disruption. Reclamation of stripmined area could restore the original ecological balance.
>
> Because aquatic organisms are sensitive to changes in water quality, effluents or spills might make the environment less suitable. Since marshes and estuaries are usually important breeding and nursery grounds, alterations in these environments could adversely affect fish and shellfish populations."

Also representative of the analysis of the environmental effect on wildlife found in the typical EIS is the following statement from the Detailed Environmental Analysis Concerning a Proposed Coal Gasification Plant and the Expansion of a Strip Mine Operation Near Burnham, New Mexico:8/

> "The wildlife population density in the area in question is relatively low. Some change in predator-prey relationships will probably occur on a temporary basis in the immediate vicinity of the plant because of the increase in ambient sound level. Animals which depend on sound to warn them of danger will lose this advantage in areas where the sound level is relatively higher. Workmen who have occasion to be outside the plant proper should take particular care to avoid rattlesnakes for this reason."

7/ Federal Energy Administration, Draft Environmental Impact Statement Energy Independence Act of 1975 and Related Tax Proposals, March 1975.

8/ Battelle, Columbus Laboroatories, Detailed Environmental Analysis Concerning a Proposed Coal Gasification Plant for Transwestern Coal Gasification Co.; Pacific Coal Co. and Western Gasification Co. and the Expansion of a Strip Mine Operation Near Burnham, New Mexico Owned and Operated by Utah International Inc., February 1, 1973.

It is clear that existing EIS generally do not deal effectively with the really important environmental issues. Indeed, the existing "state of the art" is such as to make it extremely difficult, if not impossible to do so given normal financial and time constraints.

Figure 1 provides a visual representation of the nature and the scope of the environmental impact of energy development in the Four Corners Region. This figure depicts the direct and indirect effects of energy development impacting on the environment through four basic tracks--industrial development, construction and operation of a community-business complex, the demand for housing and social services, and the demand for recreation. Each of the tracks (or areas of activity) pose significant environmental questions during both the construction and operational phases of an energy development program.

For illustrative purposes we will examine the "housing and social services" and the "recreation" tracks in greater detail, looking at recreation first.

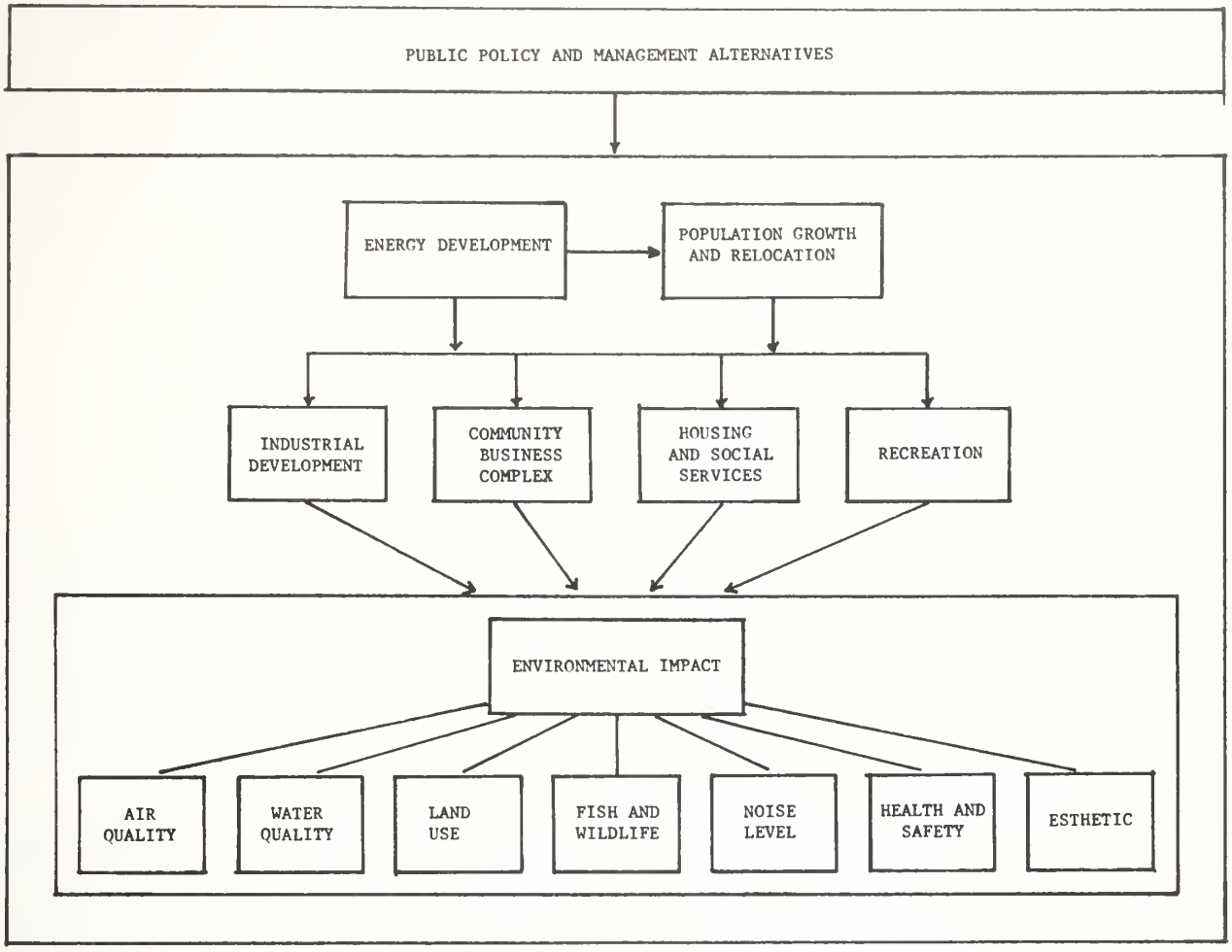
The Demand for Recreation

Major elements of the planned and projected energy development, outlined earlier in this paper are to take place in semi-arid, sparsely populated counties of the region (for example, Northern Colorado, Northwestern New Mexico and Northeastern Utah). With the exception of substantial open space in which to operate dune buggies and trail bikes, these areas offer little in the way of outdoor recreational activities. The new residents of the areas affected will thus be drawn to the mountain regions for camping, hiking, hunting, fishing, skiing and other outdoor recreational activities.

For example, a significant segment of the population of Burnham, New Mexico, a new town to be developed in conjunction with the coal gasification plants to be constructed near Farmington, New Mexico, can be expected to migrate frequently to the more appealing surrounding of the southern Colorado mountains.

Energy development associated population growth can thus be expected to place significant additional pressure on already limited and frequently crowded recreational areas in the Four Corners States. The environmental impact of the expanded use of existing recreational facilities and the construction of new recreational facilities--including recreational or second-home developments--can have

FIGURE 1



a significant effect on the quality of the environment in general and on fish and wildlife in particular.

The Report by the Colorado Land Use Commission, A Land Use Program for Colorado recognizing that environmental needs are evident and paramount in the mountain region of the state observes:9/

> "Intensive development of recreational communities has already irremediably scarred the scenic beauty of mountain valleys and impinged on game migration routes and winter forage areas. Inadequate sewage treatment facilities have led to the pollution of some streams. Automobile traffic--and even wood-buring fireplaces in winter retreats--has produced air pollution."

9/ Report by the Colorado Land Use Commission, A Land Use Program for Colorado.

While recognizing the environmental problems associated with increased use of limited recreational land--expanding recreational home developments in particular--we lack important basic data that would permit us to place this problem in proper perspective.

For example, land developers have been very active in bringing into existence and selling recreational properties throughout the Four Corners States and this has drawn some governmental response. At the Federal (Office of Interstate Land Sales Registration -OILSR) and State (Consumer Protection Divisions) levels effort has been made to protect the would-be landowner from the unscrupulous developer who would misrepresent the property being offered. At the same time little or no interest has been shown in the collection and maintenance of the most basic information concerning such land use activity. Accurate data (number of lots and acres in the development, homes constructed, homes

under construction, planned construction, etc.) on existing recreational/leisure or second home developments has not been available. Scattered counties have collected data on land projects and attempted to keep up to date listings of developments within their counties. Unfortunately the data are generally incomplete and no effort is made to classify developments (between recreational and residential). The data available are therefore of limited use.

For example, data provided by OILSR has been described as "probably the most significant set of data on current trends in location of recreational properties . . ."10/ But several important factors seriously limit the use of these data, including:11/

1) The data include not only recreational land projects but other types of residential land projects, e.g., new towns, mobile home parks, primary home subdivisions, etc.
2) Not all recreational land projects in the country are required to register with OILSR.

A comparison of recreational property acreage as reported by OILSR with recently available estimates that have adjusted the OILSR data for the limiting factors noted above, clearly suggests the need for improved data (see Table 3).

Without basic information on recreational land development (acreage, build-out rates, occupancy rates, recreational preferences of the recreational property owner, etc.) level and extent of water pollution, air pollution, solid waste problems, etc., associated with the continuing development of the region's recreational resources cannot be accurately quantified and included in the "planning equation."

In addition to this need for basic data on recreational land use (more specifically on recreational property developments), there are other significant information shortages and/or gaps in the existing "state of the art" of environmental analysis. These include up-to-date information on land use and land ownership, base line information concerning land and water quality against which changes resulting from energy development could be measured, the biologic classification of land reflecting the ability of an area to tolerate specific land use activities without degradation, the identification of "key" organisms in an ecosystem which most rapidly and accurately indicate the system's tolerance to specific impacts and more.

As continuing environmental research provides the critical inputs we will be in a stronger position to project accurately the likely consequences of alternative policies designed to mitigate the environmental impact of the anticipated increase in recreational land use.

TABLE 3

Recreational Property Acreage as Reported by OILSR and as Adjusted by RfF

	OILSR[1]/	RfF Adjusted[2]/
Arizona	467,015	n.a.
Colorado	824,700	n.a.
New Mexico	1,030,208	816,296
Utah	49,247	146,177

1/ Report in Richard L. Ragatz Associates, Inc. Recreation Properties, p. 507.

2/ Projections recently available from Resources for the Future, Inc. sponsored project "Second Home Development in the Southwest: Trends and Perspectives," Department of Economics, University of New Mexico. OILSR data has been adjusted based on subdivision data supplied by county land offices in each of the states included in the study and information provided by recreational property developers in each of the states.

The Demand for Housing and Social Services

What is to be the design and character of housing developments (both residential and recreational) constructed to accommodate demographic changes associated with energy development? The creation of "new communities" with the same environment (and the same environmental problems) as found in existing communities, or even worse ones, is not an attractive alternative.

To insure that population growth and relocation associated with energy development does not result in a large scale deterioration of the environment, it is essential that a

10/ Richard L. Ragatz Associates, Inc., Recreational Properties, An Analysis of the Markets for Privately Owned Recreational Lots and Leisure Homes, May 1974, p. 55.

11/ Ibid., p. 60.

variety of substantive environmental issues be examined carefully. Among these is the questions of dispersed vs. concentrated development and the following more specific but related issues:

Household Waste Treatment Systems (septic tank and extended aeration package plants)	vs	Community Sewage System
Household Wells	vs	Community Water System
Energy Corridors	vs	Energy Park Concept
Curvilinear Design	vs	Cluster Design or Planned Unit Development (PUD)
Low Density and Non-Centralized Density (mass transit impractical)	vs	High Density and Centralized Density (mass transit practical)

It should be noted that many of these issues relate to both recreational and residential development. This is particularly true of the issue of development siting. A matter clearly closely related to the issues listed above.

Reference to siting issues is simply a recognition of the fact that the environmental impact of a development of a particular design (rectilinear, curvilinear, cluster, etc.) and character (single family homes on individual lots, condominiums, mobile home subdivision, etc.) may vary significantly from one location to another. It is unlikely that a single form of development will provide the optimal level of environmental impact control for every location. Thus there is a need to examine carefully the environmental consequences of different planned development options at alternative sites.

Public Policy Options for Controlling Environmental Impacts (Land Use Control)

In view of the nature and scope of the environmental impact associated with the development of the Four Corners Region's energy resources, it becomes obvious that comprehensive, continuous land use planning and effective plan implementation is required if extensive environmental destruction is to be avoided.

In the Four Corners States as is the case in all other states except Hawaii, localities and counties have most of the power, such as it is, over land use decisions. In the 1970s recognizing that the impacts (both economic and environmental) of many projects extend beyond local or county boundaries, a few states have acted to transfer land use controls to regional (intrastate) or state levels.12/

These states have generally adopted the so-called critical areas/regional development approach, created in part by the American Law Institute in its Model Land Development Code. Under the critical areas approach, a state designates areas of statewide concern and reviews local land use decisions affecting the designated areas.13/

All of the Four Corners States employ some elements of the piecemeal approach which has been characteristic of state activity in the land use area. Components may include regulation of wetlands development, power plant siting, surface mining and subdivisions. While even this piecemeal approach is generally constructive in helping to avoid the more obvious environmental disasters, it is clear that such an approach is not adequate to deal with the complex of environmental issues associated with Four Corners energy development.

If comprehensive, integrated land use programs are to be developed each of the Four Corners states must enact and implement state land use legislation. Centralized land controls as found in the state of Hawaii, where the entire state is zoned by the state Land Use Commission into urban, rural, agricultural and conservation categories, offers perhaps the greatest opportunity for comprehensive (statewide) land use planning. The Vermont experience with an approach somewhat similar to Hawaii's suggests we must settle for less. That is, at best each of the states may be successful in enacting and implementing critical areas legislation such as that recently passed by the Colorado legislature. (The Utah legislature also passed such an act, however, the Utah Land Use Act was defeated in a referendum vote in November 1974.)

Under critical areas legislation, the state establishes criteria for areas and activities of statewide interest, and the localities or counties designate and regulate. All local

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12/ The following states have acted to transfer land use controls to regional or state levels: Colorado, Florida, Maine, Maryland, Minnesota, Nevada, North Carolina, Oregon, Utah and Vermont.

13/ James B. Coffin, Editor, A Summary of State Land Use Controls - July 1974, Land Use Planning Reports, Plus Publications Inc., p. 2.

decisions in designating areas and activities of statewide interest and the regulation of these through local land use controls are reviewed by a State Land Use Commission.14/

The Commission established under such legislation is responsible for the identification and formulation of land use goals and policies, the development of programs to carry out these policies and the development of an organizational structure to implement the programs.

The Commission is in a position to coordinate the actions of a variety of state agencies including the State Engineers Office, the Environmental Improvement Agency, the State Planning Office, etc., in efforts to achieve state land use objectives.

The Commission is similarly in a position to develop and implement new and innovative measures to encourage planned, orderly, environmentally acceptable land use development. Such innovative measures may include the initiation of a state land acquisition program focusing on environmentally critical areas, where regulation cannot provide adequate or appropriate control or trading or selling small, scattered parcels of state land that do not serve state land use objectives effectively in order to obtain parcels of more critical interest to the state.

A resourceful State Land Use Commission will find other innovative opportunities for mitigating the environmental consequences of energy development through the exploitation of existing state and federal air and water quality legislation. For example, strict enforcement of air and/or water quality standards may provide an effective deterrent to the "paper subdivision" (lots that are marketed, but never developed) and other developments not consistent with state land-use objectives.

The states of Arizona, New Mexico and Utah are in a position to benefit from the work of the Colorado Land Use Commission in its development of A Land Use Program for Colorado. Parts of the Colorado Program will no doubt be found to be appropriate for all the states and can be thus easily incorporated into other state programs. All four states must proceed to develop state land capability maps and upon the passage of appropriate legislation designate areas of statewide concern, including in this category both scenic and environmentally critical areas. Through the efforts of an effective State Land Use Commission the results of continuing environmental research may significantly influence land use and energy development decisions of considerable consequence to the residents of this region.

But even should the Four Corners States develop reasonable effective intra-state approaches the problem of environmental management for the region will not have been solved. The dependence of each of the states on the Colorado River for water presents problems of both quantitative allocation and quality management which are inherently interstate in character. Air quality degradation will not respect state boundaries, and as we have already noted development in one state will have land use impacts in others. A creative regional response is needed both in institution building and policy formation. To create a regional compact whose responsibilities would extend across the whole range of environmental concerns would be an enormous innovation in American government and is quite likely beyond the power of achievement at the present time. But the formation of some form of effective regional body appears to us to be an urgent need and we hope the governors will use the various forums open to them to vigorously explore the possibilities.

14/ Ibid., p. 8.

Stream Chemistry as a Tool in Evaluating Ski Area Development[1]

James R. Gosz[2]/

Abstract.--Studies have been made of a series of ski area developments representing increasing impact severity to a single area as well as different areas subject to different types of impacts. The major factor affecting water quality was road salt application. Sewage disposal affected inorganic water quality to a minor degree while poma lift construction and light tree removal had no measurable effect on the water quality parameters measured. Site productivity appeared to be more affected than water quality.

INTRODUCTION

Man's use and development of wildlands in the Rocky Mountains is expected to increase significantly in the near future. The effect of this increased human impact is difficult to assess because of the complexity of natural ecosystems and the lack of information about the delicate adjustments that maintain a balance in these systems (Bormann and Likens 1970). As a result land managers have difficulty in predicting the full range of consequences that a particular development will have. The issue is further complicated because of the pressure on land managers to emphasize maximizing the output of some product or service with less importance being placed on the secondary effects. It is imperative that new tools be developed which can aid land managers in predicting the full consequence of land use and development. One of the tools which may be of significant benefit is the analysis and interpretation of water quality data. The potential value of water quality as a tool to evaluate land management results because of the nutrient and energy linkages that exist between terrestrial and aquatic systems (Likens and Bormann 1974). Because of these linkages the effects of a disturbance to the terrestrial system are often transmitted to aquatic systems.

Life depends on a supply of chemical elements all of which tend to circulate in the biosphere in characteristic pathways. Recognition of the importance of these element pathways (cycles) to man's activities has generated intensive study of biogeochemical processes. Studies of nutrient budgets and cycles have become a popular method of analyzing ecosystems as projects in the Northeast, Southeast, Northwest, and Southwest are using cycles of elements to characterize the efficiency of undisturbed ecosystems (Likens and Bormann 1972, Gosz et al. 1972, 1973, Gosz 1975, Johnson and Swank 1973, Cole et al. 1973). A significant result of these studies has been the identification of the conservative nature of undisturbed ecosystems with respect to their nutrient capital. An efficient biotic community, in terms of storing and cycling processes, has less nutrient capital flushed from the system via the drainage water. The ability of natural systems to maintain nutrients is partially the result of

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1/ Paper presented at the symposium on Man, Leisure and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

2/ The author is an Associate Professor at the University of New Mexico, Albuquerque, New Mexico 87131.

the biological processes within that system and any change imposed on those processes often affects the ability of a system to maintain its nutrient status. This has been shown in numerous studies by the increased nutrient levels in the drainage water of the area after disturbance. Stream transportation (dissolved and particulate material) has been particularly useful in evaluating the efficiency of an ecosystem in conserving its nutrient capital. If output studies (by stream transportation) are accompanied by studies of inputs to the system (precipitation and sedimentation), then it is possible to gain a comprehensive view of the dynamic status of the ecosystem. This watershed approach to studies of nutrient cycling is very popular because of its advantages in evaluating interrelationships between biota, nutrient cycles, hydrologic cycle, and energy flow in a single system (Bormann and Likens 1967). It also makes it possible to compare different ecosystems or to evaluate the effect of land management practices on ecosystems.

The effect of a particular land management practice may be evaluated in two ways: 1) in terms of the effect on the land area itself (e.g. loss of nutrient capital, reduced productivity) or 2) the effect of the change of stream parameters on stream organisms (e.g. eutrophication). In either way the study of water quality can provide valuable data in the evaluation of the effect. The objective of this paper is to demonstrate the use of water quality as a tool in evaluating disturbances to natural land and water systems. Specifically, it evaluates the development and operation of a ski area on a spruce-fir forest ecosystem and its stream in New Mexico. Studies have been made of a series of developments representing increasing impact severity to a single area as well as different areas subject to different types of impacts. The relative importance of each type of disturbance is documented in terms of its effects on water quality. The long term goals of this research are to identify the tolerance levels of the terrestrial and aquatic portions of this ecosystem to ensure its health and self-maintenance properties.

STUDY AREA

The study area is the Santa Fe Ski Basin located about 15 km northeast of Santa Fe, New Mexico in the Sangre de Cristo Mountains. The ski basin is located at the headwaters of the Rio en Medio, a perennial stream. Present and planned developments of the ski area provide a unique opportunity to study the impact of several types of disturbances. The ski basin watershed can be divided into three areas based upon types of useage and topographic boundaries (fig. 1).

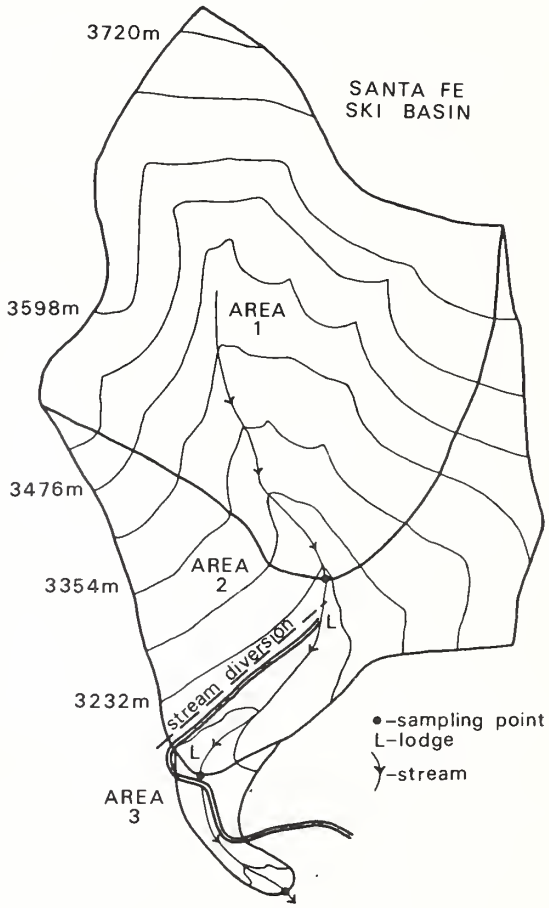

Figure 1.--Three study areas on the Santa Fe Ski Basin, New Mexico. The total area of the ski basin is 259.9 ha.

The upper area (area 1; 163 ha) is only affected by skiing activity (ski runs, poma lifts) and the stream is gauged which gives us detailed water discharge rates and yield data. Prior to the summer of 1972 area 1 was similar to an undisturbed watershed. Only limited

skiing occurred as a result of a poma lift and a single ski run located along the south boundary of the watershed. During September and October of 1972 the poma lift along the south boundary of area 1 was replaced with a new poma lift (Model T210). The major impact was that of constructing new concrete piers for the towers. Approximately 78 m^3 (102 cu yds) of concrete were used for the 15 towers and bottom foundation.

During the summers of 1973 and 1974, an additional poma lift (Model H90) was constructed in the center of area 1 along the stream. This poma lift consists of 14 towers traveling about 1160 m (3800 ft) horizontally (300 m vertical lift). The major construction activity consisted of blasting to remove boulders in the lift path and pouring concrete footings for the towers. About 61 m^3 (80 cu yds) of concrete was required for the entire lift. The lift required very little tree removal since it was placed in a relatively open area.

During the summer of 1974, two ski runs were cleared in area 1 to serve the Model H90 poma lift. Again, because of the rather open terrain concerned, the number and basal area of trees removed was small. A total of 907 stems ranging from 2 to 33 cm (1 to 13 inches) diameter (stump height) were cut, however, because of the abundance of small trees (average stem diameter was 9.4 cm) the total basal area removed amounted to only 7.3 m^2 (68.5 sq. ft.) on an area of about 2 ha.

The middle portion of the ski basin (area 2; 92 ha) is the drainage area for most of the ski runs plus a chair lift, a parking lot, drainfields from the waste disposal systems of 2 lodges, and 0.8 km of road subject to road salting practices. A stream diversion, consisting of a gate dam and underground pipe, diverts the stream from area 1 out of the study area (fig. 1). Therefore, water quality data collected from area 2 reflect impacts on that area only.

The lower portion of the ski basin (area 3; 4.9 ha) does not have skiing activity, however, it is affected by a parking lot and 0.5 km of road which is subject to road salting practices during the winter.

The vegetation of the ski basin is primarily Engelmann spruce (Picea engelmannii Parry) and corkbark fir (Abies lasiocarpa) var. arizonica (Meriam) Lemm.) with small areas of aspen (Populus tremuloides Michx.) scattered throughout the basin below 3355 m (11,000 ft.). Alpine tundra occurs on a small area above 3660 m (12,000 ft.). A detailed report of the topography and climatic factors is available (Gosz 1975).

METHODS AND PROCEDURES

Quantification of precipiation, streamflow, and the concentrations of nutrients entering and leaving the basin allow a calculation of nutrient flux for individual areas of the watershed. Although a number of nutrients and heavy metals are under investigation, this report deals only with calcium, magnesium, sodium, potassium, nitrate-N, and chloride.

Precipitation was recorded by a combination of standard and recording rain gauges. During the period Oct. 1971-Sept. 1973 three precipitation stations were in service at 2377, 2987, and 3292 m elevation. Since September 1973, seven precipitation stations have been in service over the elevational gradient at approximately 300 m intervals. Regressions of precipitation on elevation were calculated for annual precipitation and applied to individual areas of the ski basin to estimate the weighted areal precipitation (see Gosz 1975). Rainfall samples for chemical analysis were collected weekly from polyethylene collectors described by Likens et al. (1967). The design of these collectors eliminates concentration of solutes by evaporation. Snowfall was collected in large plastic "garbage cans" (about 2 m above the ground) lined with clean plastic bags. The bags were removed and closed preventing contamination during transit to the laboratory. The precipitation samples contained chemicals from dry fallout, thus, the analyses estimate bulk precipitation. Samples contaminated by bird droppings, etc., were disregarded. The product of precipitation volume and chemical concentration estimate the nutrient input for the area under study.

Streamflow was measured continuously at the base of area 1 by a gaging

station. During winter months the weir was heated to prevent ice from forming on the V-notch. Areas 2 and 3 are not gauged, therefore, discharge volumes were estimated using the weighted areal precipitation and evapotranspiration data for the elevational range of the ski basin (see Gosz 1975).

The water diversion which transfers water from area 1 outside the ski basin has a capacity of 1.95 cfs. During 1973-74 stream discharge from area 1 did not exceed that capacity, however, during 1972-73 discharge rates were significantly higher during the spring snow melt period causing the stream to overflow the diversion and enter the stream system of areas 2 and 3. The volume of water entering the lower areas was calculated from the difference between 1.95 cfs and the actual discharge rate of area 1.

Samples of stream water for chemical analysis were collected weekly at the base of each area of the ski basin except during periods of high discharge when more frequent sampling occurred. More frequent sampling also occurred from area 1 during periods of construction activity (e.g. during blasting operations). The samples were collected in 500 ml acid washed polyethylene bottles and acidified to prevent chemical change.

Cation chemical analyses were performed on a Perkin-Elmer Model 306 Atomic Absorption Spectrophotometer. Sodium and K^+ were analyzed directly from sample bottles, however, Ca^{++} and Mg^{++} analyses were made after pretreatment with a lanthanum-HCl buffer to avoid interferences (Slavin et al. 1963). Nitrate-N was analyzed by the ultraviolet procedure (Standard Methods 1971) and chloride was analyzed by a chloride specific ion electrode. The product of stream volume and chemical concentration estimates nutrient output from a watershed. It was necessary to use the water year (October through September) to calculate annual output because of significant snowfall during October through December which does not leave the watershed until the following spring.

RESULTS AND DISCUSSION

HYDROLOGY

This paper presents data for two years, Oct. 1972-Sept. 1973 and Oct. 1973-Sept. 1974. These two years were very different hydrologically which is fortunate because our results should reflect the range of variation that would be encountered in this area. Table 1 shows hydrological data for the 3 areas of the ski basin which demonstrates the variability that can occur on a year to year basis in this semi-arid climate.

Table 1.--Hydrological data for 3 areas of the Santa Fe Ski Basin. Values are in cm of water

Area	Year	Precip.	Run-off	Evapo-transpiration
1	72-73	91.4	86.9	4.5
	73-74	58.2	27.9	30.3
2	72-73	83.1	74.8	8.3
	73-74	54.2	21.7	32.5
3	72-73	74.4	65.5	8.9
	73-74	49.6	17.4	32.2

Approximately 75% of the above average precipitation in 1972-73 occurred as snow and the resulting spring snow melt caused runoff to greatly exceed evapotranspiration. During 1973-74 the much smaller precipitation volume went primarily into soil moisture rechage (resulting from the very dry preceeding summer and fall) and evapotranspiration became a dominant factor. This can be readily seen in figure 2 which shows the significant difference in stream discharge during the two-year period. It should be obvious that these results will play an important role in any discussion of stream chemistry.

STREAM CHEMISTRY

Although stream discharge varied by as much as a 5-fold difference between the two years, natural stream chemistry variation (area 1) was much less (fig. 3).

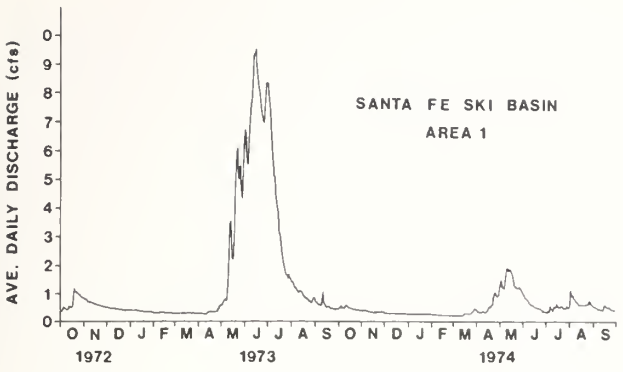

Figure 2.--Average daily stream discharge in cfs from area 1 of the Santa Fe Ski Basin.

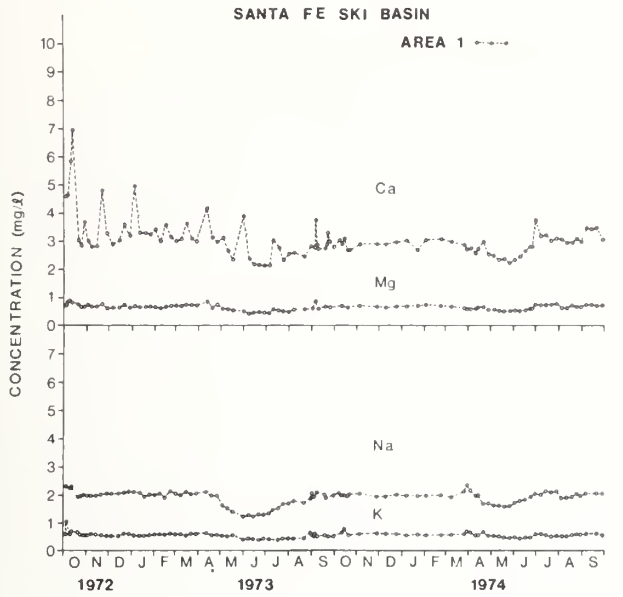

Figure 3.--Stream water concentrations of Ca^{++}, Mg^{++}, Na^{+}, and K^{+} in area 1 of the Santa Fe Ski Basin. These data identify the variability of natural stream chemistry for this area.

Seasonal patterns did occur with low concentrations associated with the high discharge volumes during the spring snow melt. Sodium and Ca^{++} showed the most pronounced seasonal patterns, however, all four cations (Ca^{++}, Mg^{++}, Na^{+} and K^{+}) in the stream water of area 1 were significantly, negatively correlated with stream discharge for both study years. The major difference between the two years was that cation concentrations were most highly correlated with the log of the discharge rate during the very wet year and directly with the discharge rate during the dry year. The major difference between a wet and dry year in terms of cation concentrations in natural stream water of this area seems to be a slight dilution effect during the wetter year. Nitrate levels were low and very consistent during the 2-year period and as a result this nutrient was not correlated with discharge or other cation concentrations in the stream water of area 1.

Of all ions studied Ca^{++} was demonstrated to be the most variable and the variation was higher during the wet year than during the dry year. Much of this variation appears to be the result of the affinity which the divalent ion Ca^{++} has for exchange sites on soil and organic colloids and the amount of water moving through the soil (resulting in stream flow) which can remove Ca^{++}. Since stream discharge varies throughout the day, sampling at different times of the day can account for a certain amount of variability in the data. Another factor which may add to the Ca^{++} variability is Ca^{++} held on exchange sites of the suspended particulate load of the stream. Because of its replacing ability Ca^{++} would be the dominant cation held by this material (Brady 1974, White 1975). The particulate load of a stream generally is positively correlated with discharge (Bormann et al. 1974) and this factor may be partly responsible for the Ca^{++} variability. Although these daily patterns tend to show a positive relationship between Ca^{++} concentrations and discharge, the overall effect of spring snow melt is that of dilution and its dominance causes a significant negative correlation between cations and discharge on an annual basis.

Clearing of ski runs and poma lift construction did not appear to significantly affect the water chemistry of area 1 (fig. 3). The large peaks for Ca and K in October 1972 were the only occurrences which may be attributed to poma lift construction. The occurrence of the peaks resulted from rain on 3 consecutive days (2.2 cm) following a 2 week dry period. Stream discharge increased significantly causing higher levels of all cations in the stream water. This same pattern happened on other of our study watersheds, however, the increase was not as pronounced.

Construction of the model H90 poma lift in the center of area 1 represents a more significant impact since it is closer to the stream, distrubed new land, and required blasting to remove boulders from the construction site. Through all of this activity during the summer and fall of 1973 stream chemistry varied little. In this case the reason appeared to be the lack of rain as the summer and fall months were very dry. Several small peaks can be seen during September and October which were correlated with precipitation events, however, because of the low soil moisture, little runoff occurred. Higher moisture levels would no doubt have caused significantly higher erosion and increased concentrations of cations.

The clearing of vegetation during the summer of 1974 did not significantly alter concentrations of cations or anions. A number of studies have demonstrated that ions such as Ca^{++}, Mg^{++}, K^{+}, and nitrate-N increase significantly in stream water after vegetation clearing (Likens and Bormann 1972, Likens et al. 1970, Bormann et al. 1968, U.S. Forest Service 1971, Fredriksen 1970). Weighted average concentrations of nitrate-N in the stream water of area 1 did not differ between the 1972-73 and 1973-74 water years (0.29 mg/l) nor was there any increase during or after the tree removal activity. The small fluctuations in cation concentrations shown in figure 3 are a function of discharge volume and do not seem to be related to tree removal since they also occur in the streams of other watersheds. The reason is no doubt related to the small area cleared, the low density of trees with grass cover in open areas, and the small size of individual trees. Another factor may be the method of cutting. Since most individuals were growing in the open, they had branches down to the ground. The stems were cut above the lowest whorl of branches for the purpose of holding the snow pack, however, this also had the effect of keeping the root system alive and functioning. Data is not yet available for the 1974-75 water year, therefore, we cannot say if increased N levels occur with time after the cutting.

The middle portion of the ski basin (area 2) is the area of most activity. Figure 4 demonstrates the difference in stream chemistry between areas 1 and 2. Since the stream from area 1 is normally diverted out of the ski basin the difference in water quality reflects a difference in land use. Cation concentrations were always higher in area 2 than in area 1 and more variable with Ca^{++} and Na^{+} showing the largest change (table 2, fig. 4).

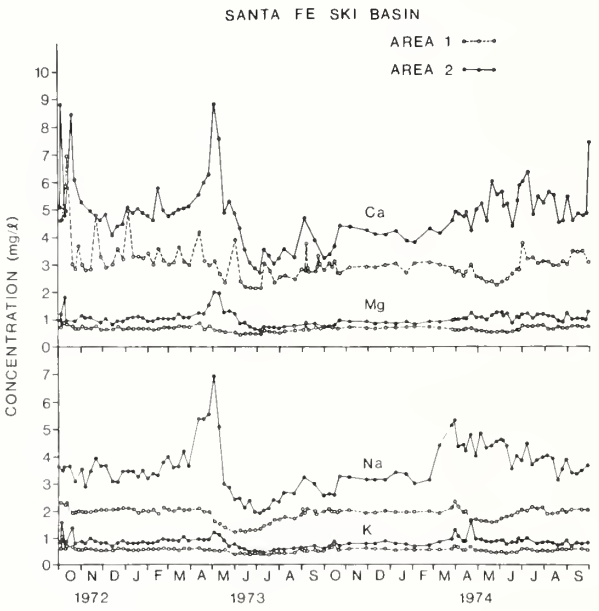

Figure 4.--Stream water concentrations of Ca^{++}, Mg^{++}, Na^{+} and K^{+} for areas 1 and 2 of the Santa Fe Ski Basin.

The pronounced pattern of lower cation concentrations during the high spring stream discharge also was affected. During 1972-73 the very high spring discharge rates caused a dilution, however, during 1973-74 the much smaller spring discharge was accompanied by higher cation concentrations than the preceeding winter. One explanation for this difference may be the fact that the capacity of the stream diversion system was exceeded during the 1972-73 year and the overflow of water from area 1 may have diluted cation concentrations in area 2. In 1972-73 the cations in the stream water of area 2 generally were significantly, negatively correlated with discharge, however, the 1973-74 water year shows non-significant or positive correlations with discharge. These results further support the contention that significantly different factors affecting stream chemistry are involved in the two areas.

Table 2.--Yearly average concentrations of nutrients in stream water of three areas of the Santa Fe Ski Basin

	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	NO_3-N	Cl^{-}
	Concentration (mg/l)					
Area 1						
1972-73	3.23	0.68	1.90	0.57	0.29	0.3
1973-74	2.94	0.70	1.97	0.59	0.29	0.3
Area 2						
1972-73	4.91	1.06	3.56	0.74	0.51	6.4
1973-74	4.88	1.05	3.87	0.88	0.36	12.2
Area 3						
1972-73	5.53	1.15	6.30	0.80	-	11.9
1973-74	5.20	1.16	5.02	0.93	-	17.1

The levels of nitrate-N in the stream water of area 2 were not related to stream discharge, however, they were significantly higher and more variable than those from area 1 (table 2). The drainfields of the sewage disposal system are thought to be the source of this nutrient. This will be discussed more later in this report.

Area 3 shows higher cation concentrations than either area 1 or 2 (table 2, fig. 5). The stream water from area 2 also flows through area 3, therefore, relations between discharge and ion concentrations are similar to those from area 2. However the difference in the magnitude of the concentrations between areas 2 and 3 identify additional effects occurring in area 3. Calcium and Na^{+} were the ions most significantly affected.

The higher concentrations of all ions in areas 2 and 3 (table 2) represent a deterioration of water quality, however, the increases generally are not large enough to affect downstream organisms. The ion which comes closest to pollution levels is Cl^{-} which reached concentrations as high as 55 mg/l (March 31, 1974) for a brief period. This level does not exceed the tolerance levels for any native fish (trout are affected by 400 mg/l, McKee and Wolf 1963) and of stream invertebrates only the Tendipedidae or midges have fresh water species with tolerances below 10 mg/l (Tarzwell 1965). It is not known if Tendipedid species have been affected in the stream below the ski area.

Chlorides are considered to be among the most troublesome anions in irrigation water, however, concentrations of Cl^{-} in the stream water have not reached levels reported harmful to plants (McKee and Wolf 1963). According to the irrigation water classification shown in McKee and Wolf (1963) the water of all three areas of the ski basin can be used on almost all soils and for almost all crops without detrimental effects.

Since the three areas differ in size and, therefore, volume of water discharged, concentration differences only reflect the degree of change. Calculating the total loss or output from each of these areas demonstrates the magnitude of the difference. Table 3 lists the total cation loss per unit area (kg/ha) for each of the 3 areas. These values again show increased losses from area 1 to area 3, however, the increase from area 2 to area 3 is the most pronounced. Again, Ca^{++} and Na^{+} show the greatest degree of change. The major question now involves the source of cations being lost from the basin. Are they lost from within the system, which may affect future productivity, or do these quantities come from inputs to the system both natural (i.e. precipitation) and man-caused (i.e. road salt, sewage)? Table 3 also shows cation inputs to the area in precipitation calculated from studies of precipitation chemistry and volumes.

Table 3.--Nutrient budgets for 3 areas of the Santa Fe Ski Basin during 1972-1974. Values are expressed in kg/ha

	1972-73			1973-74		
	Precip. Input	Stream Water Output	Net Loss	Precip. Input	Stream Water Output	Net Loss
Ca^{++}						
area 1	7.2	24.5	-17.3	6.3	8.0	-1.7
area 2	7.2	39.1	-31.9	6.4	10.2	-3.8
area 3	7.2	240.6	-233.4	6.4	20.6	-14.2
Mg^{++}						
area 1	0.6	5.0	-4.4	1.0	1.9	-0.9
area 2	0.6	8.5	-7.9	1.0	2.2	-1.2
area 3	0.6	52.9	-52.3	1.0	6.0	-5.0
Na^{+}						
area 1	1.0	13.6	-12.6	0.8	5.3	-4.7
area 2	1.0	28.9	-27.9	0.8	8.1	-7.3
area 3	1.0	482.4	-481.4	0.8	52.7	-51.9
K^{+}						
area 1	2.1	4.3	-2.2	1.1	1.6	-0.5
area 2	2.0	5.8	-3.8	1.2	1.8	-0.6
area 3	2.0	35.3	-33.3	1.2	4.1	-2.9

Cation inputs per unit area were very similar over the three areas of the ski basin and cannot explain any of the differences seen in the outputs. As a result of the similarity of inputs the patterns of cation flux, or net loss, were very similar to those of cation output.

The two major man-caused inputs to the system were sewage effluents from the lodges and road salt. It is difficult to measure the quantity of sewage effluent in the ski area because of the use of septic tanks and drain fields. The best approximation is through an estimate of the quantity of water going through the waste disposal system. The nutrient concentrations used to calculate total nutrient quantities were taken from Metcalf and Eddy (1972) and should give a reasonable estimate of septic tank effluent (Segall, personal communication). Sewage effluent concentrations of Cl^{-}, Na^{+}, Ca^{++}, Mg^{++}, and K^{+} used were 215, 155, 50, 32, and 8.8 mg/l, respectively. It is estimated that 20 gal/day per capita enters the sewage system of this recreational development (Metcalf and Eddy 1972). The number of skiers ranged from 60,000 to 75,000 per ski season which is taken to be 100 days (Pitcher, personal communication).

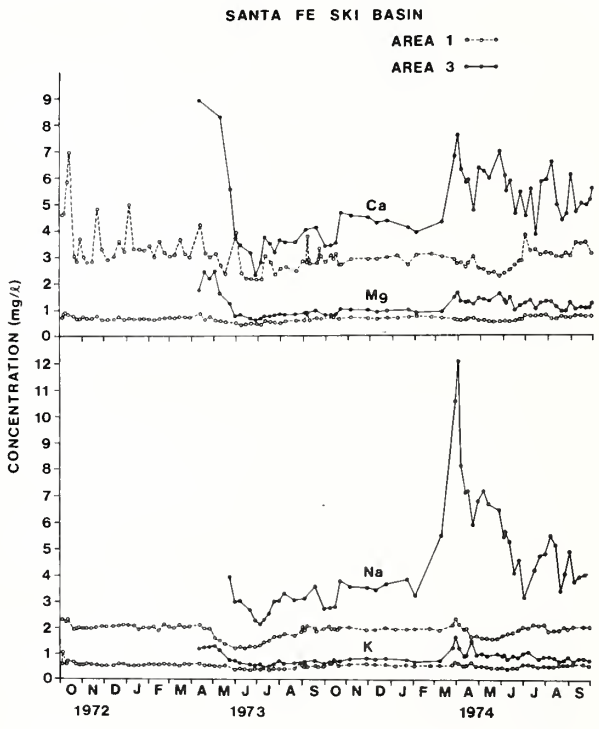

Figure 5.--Stream water concentrations of Ca^{++}, Mg^{++}, Na^{+} and K^{+} for areas 1 and 3 of the Santa Fe Ski Basin.

Table 4.--Element budgets for areas 2 and 3 of the Santa Fe Ski Basin during the 1972-73 water year. Values are expressed in kg/total area

	Inputs			Outputs	Net
	Precip.	Sewage	Road Salt	Stream Water	Gain or Loss
Area 2					
Na^+	92	790	3500	2657	+1725
Ca^{++}	662	250	44	3599	-2643
Mg^{++}	55	160	4	784	-565
K^+	184	45	28	533	-276
Cl^-	156	1100	6125	6458	+923
Area 3					
Na^+	5	-	2100	2634	+529
Ca^{++}	35	-	28	1179	-1116
Mg^{++}	3	-	4	259	-252
K^+	10	-	16	173	-147
Cl^-	7	-	3675	6817	-3135

These figures yield an estimate of the total kg of nutrients added to area 2 in the sewage systems (table 4).

Road salt comprised the other major man-caused input of nutrients to the basin. Approximately 1750 kg of a sand-salt mixture were applied per mile of road during each salting trip. Chemical analysis of the salt mixture showed it to be 16.7% Cl^-, 9.8% Na^+, 0.3% $SO_4^=$, 0.13% Ca^{++}, 0.08% K^+, and 0.015% Mg^{++}. The remainder was mineral sand (less than ¼ in dia.). Approximately 40 salting trips were made during the winter of 1972-73 which yields total inputs of nutrients via road salt shown in table 4. A comparison of natural and man-caused inputs shows that road salt supplied the largest total quantity of nutrients primarily as NaCl, sewage effluent supplied the majority of Mg^{++}, and precipitation supplied the majority of Ca^{++} and K^+. Table 4 also shows the total outputs (in stream water) of these nutrients during the 1972-73 year which, except for Na^+ and Cl^- in area 2, were much greater than the inputs. In area 2 the greatest net loss occurred for Ca^{++}. The reason would seem to be the mass action replacement of Ca^{++} held to exchange sites in soil by the large quantities of Na^+ added to the system (Brady 1974). Significant quantities of Mg^{++} and K^+ were lost from the system by the same action. Area 2 showed a net increase in Na^+ and Cl^- for the year, however, the distribution of this material is not known. Sodium may be occupying more of the soil cation exchange capacity or precipitated NaCl salt may explain the accumulation. During the summer cattle have been seen licking the road shoulders, presumeably for salt.

Area 3 showed a similar pattern except for a net loss of Cl^-. This large net loss of Cl^- is difficult to explain and suggests that the input of road salt was underestimated. Nevertheless, the relatively large loss of Ca^{++}, Mg^{++}, and K^+ from this small area (4.9 ha) is consistent with results from area 2.

Since the dominant effect appears to be a result of road salt application the impact will not be distributed evenly throughout the ski basin area but concentrated along roads, parking lots, and perhaps water courses. The values in table 3 show average losses per hectare for the entire area which may be misleading. For example, the more remote portions of area 2 no doubt experience nutrient inputs and outputs similar to the more natural area 1. Close to the road, however, the nutrient losses/hectare are significantly higher than those shown for area 2, perhaps 50-fold. These excessive losses must in some way affect the growth and productivity of the organisms in those areas. The literature shows numerous studies of vegetation damaged by road salt, however, I know of no published literature of the effects of road salt

on site productivity in the mountainous West. The effects may range from accumulated toxic effects of Na^+ and Cl^- on growth to significant alteration of soil physical properties affecting root and water penetration (McKee and Wolf 1963, Piatt and Krause 1974).

The effects of Na^+ on soil physical properties result primarily from the breakdown of the granular soil structure. Calcium and Mg^{++} in the proper proportions maintain soil in good condition of tilth and structure because their divalent charge and low hydration cause them to be tightly held by soil colloids enhancing the coagulation of colloid particles. Monovalent Na^+ which is highly hydrated is not tightly held by colloid particles permitting individual particles to repel each other and to stay in dispersion (Brady 1974). In most normal soils Ca^{++} and Mg^{++} are the principal cations held by the soil in replaceable or exchangeable form, with Na^+ consisting of a small percentage (i.e. 3 to 7%, McKee and Wolf 1963). An increase of the percentage Na^+ to as much as 12 or 15% causes the granular soil structure to begin to break down when the soil is moistened. Various changes take place resulting in the sealing of pores and a decrease in soil permeability. With further increases in the Na^+ percentage, the soil continues to deteriorate and its pH increases to the level of alkali soils (McKee and Wolf 1963).

In a normal soil Ca^{++} is present in higher concentrations than Na^+ because of its prevelance in the common minerals of rocks and of soil (Hem 1970) and because of the greater affinity that Ca^{++} has for soil exchange sites (Brady 1974). It is easier for Ca^{++} to replace Na^+ in the exchange complex than for Na^+ to replace Ca^{++}, and unless the Na^+ in the soil solution is considerably in excess of the Ca^{++}, no Ca^{++} will be replaced. However, in areas subject to road salting Na^+ is greatly in excess of Ca^{++} and Mg^{++} and through mass action replaces these ions on the exchange complexes. This appears to be the explanation for the significant losses of Ca^{++}, Mg^{++} and K^+ in areas 2 and 3 of the ski basin. Since Ca^{++} is the dominant base ion in the soil of this area, it should be influenced to the greatest degree by road salt. This seems to explain why Ca^{++} and Na^+ show the greatest change in the stream water of areas 2 and 3 (fig. 4,5).

Vegetation requires Ca^{++} in relatively large quantities in relation to Na^+ or other base elements (Rodin and Basilevich 1967) and the replacement of Ca^{++} by Na^+ on the exchange sites in soil must reduce the ability of vegetation to obtain Ca^{++} as well as other elements. It is difficult to predict whether this has more effect than deterioration of the soil physical characteristics or Na^+ and Cl^- toxicity, however, the combination of all of these significantly damages vegetation (Piatt and Krause 1974).

THE TRILINEAR DIAGRAM--A TOOL

In many areas where land development is occurring one may not be fortunate enough to have gaged, calibrated watersheds to allow the quantification of nutrient outputs. Therefore, it would be difficult to identify the factor or factors which are primarily responsible based on nutrient fluxes. One method of water quality interpretation which can aid in the identification of major disturbance factors is through the use of the trilinear diagram technique. If one considers only the major dissolved ionic constituents in milliequivalents per liter and lumps K^+ and Na^+ together the composition of most natural waters can be closely approximated in terms of 3 cationic species (Hem 1970). If the values are expressed as percentages of the total milliequivalents per liter of cations, the composition of the water can be represented by a trilinear plotting technique (fig. 6).

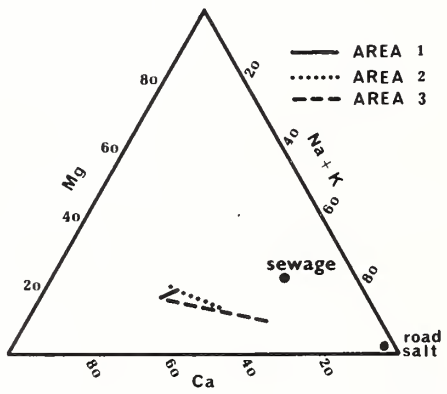

Figure 6.--Trilinear plotting diagram for the interpretation of water quality. The lines represent the range of water quality characteristics for 3 areas of the Santa Fe Ski Basin during a 2 year period.

Each vertex represents 100% of a particular ion or group of ions. The composition of the water with respect to cations is indicated by a point plotted in the triangle. The coordinates at each point add to 100%. The most useful application of this technique is testing water quality to determine whether a particular water may be a simple mixture of others or whether it is affected by solution or precipitation of a single salt. It can be easily shown that the analysis of any mixture of waters A and B will plot on the straight line AB in the plotting field (where points A and B are for the analyses of the two components) if the ions do not react chemically as a result of mixing (Hem 1970). Or, if solutions A and C define a straight line pointing toward the Na^+ vertex, the more concentrated solution represents the more dilute one spiked by addition of a Na^+ salt. These characteristics make this method ideal for evaluating the different sources of nutrients in an area in relation to water quality. Figure 6 demonstrates the plotting method for the 3 areas of the Santa Fe Ski Basin. The line for each area represents the range of water chemistry characteristics during the 2 water years. For area 1 the range is quite small with somewhat higher levels of Ca^{++} found in stream water during the high discharge during 1972-73. The high discharge causes the points to fall somewhat closer to the Ca^{++} vertex. The lines for areas 2 and 3 show that all of the water analyses during a 2-year period fall on a straight line between the natural water quality (area 1) and a point representing the chemical makeup of road salt. The interpretation is that the water quality in the areas 2 and 3 is primarily affected by the solution of road salt. During the spring snow melt, water quality analyses plot on the line nearer the Na^+ plus K^+ vertex. Since K^+ changes little over the course of the year this is primarily the result of Na^+ changes. During the fall and winter months (before snow melt) water quality analyses plot near the line representing natural water quality. Although the water quality of areas 2 and 3 plot on a straight line toward the Na^+ vertex the two lines shift apart as the influence of road salt decreases. This may be the result of the influence of the sewage input into area 2. It has been shown that sewage accounts for the major input of Mg^{++} to the area (table 4). Figure 6 also shows the plot representing the chemical analysis of sewage effluent. Since water quality analyses do not plot on a line between natural water quality and sewage effluent, sewage cannot be the major factor affecting water quality. Its effect seems to be minor in this case by slightly increasing the proportion of Mg^{++} at certain times during the year in the immediate area of the source. Current research is trying to verify the minor role of the effect of sewage effluent on inorganic water quality in this area through intensive studies of anions. A similar trilinear plotting method can also be used for major anions and since NO_3-N is significantly higher in sewage effluent than in either natural stream water or road salt the plotting technique should identify which of these two effects are dominant and the period during which each is dominant.

This technique would seem to be a very simple and useful method for a land manager who is responsible for maintaining water quality or evaluating the effects of various practices. A number of portable water analysis kits are available which enable a land manager to make immediate and frequent on the spot checks on the health of a particular aquatic or terrestrial ecosystem.

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Impact of Recreation Use and Development on Water Quality in Arizona: An Overview[1]

Stanley K. Brickler and Jack G. Utter[2]

Abstract.--Water quality studies of recreation waters in the State of Arizona has become of major importance to public land management agencies. Participation in water-based recreation activity has increased greatly within the last decade. Concern has been expressed by land managers regarding the impact of recreation use and development on water quality. This report examines water quality parameters used to determine water quality conditions, current research, and offers guidelines of control.

INTRODUCTION

Arizona, the 6th largest state in the U.S., comprising 72,688,000 acres (113,909 square miles) is composite of six life zones ranging from the lower Sonoran Desert to Alpine Tundra. Topographic relief varies from desert valleys, canyons, and low mountain ranges to high plateaus and mountainous peaks. Climatic conditions of each area are considerably different and have distinctly influenced development in each region.

The abundance of Arizona's unique natural resources has accounted for the upsurge in industrial and population growth. Leading industry in the state include manufacturing, mining, agriculture, and tourism and recreation. Population statistics show growth patterns for Arizona as 1.3 million in 1960, 2.1 million in 1974, and projected 2.6 million by 1980 (Arizona Statistical Review 1974).

Associated with economic and population growth patterns are accelerated rates of participation in outdoor recreation activities. This is especially the case for water-based recreation pursuits. Demands placed on existing water based recreation facilities in Arizona generated by the scarcity of surface water (less than .3% of Arizona's total surface area) have in some areas resulted in over capacity use and abuse of existing resources (Statewide Comprehension Outdoor Recreation Plan 1973). Every available stream and reservoir is pursued for its recreation potential, and in many areas, access in the only constraint limiting unrestricted use. However with the advent of "all-terrain vehicles," virtually all man made and natural water bodies and streams of Arizona are accessable.

Increasing public pressure for water-based recreation opportunities has caused recreation land managers to recognize that negative impacts may occur on the water resources under their management jurisdiction. Adjacent to many of the relatively limited surface water resources in Arizona are numerous second homes, resorts, campgrounds and day-use sites, all with related waste disposal considerations. Significant questions have been raised regarding these large numbers of facilities and the frequent heavy use they receive: (1) Is water-based recreation activity contributing bacterial and nutrient pollutants to the decline of Arizona's surface water environments? and (2) What types of procedures should be established to identify and correct existing and future recreational water quality problems? Examination of these questions and their implications is essential to the under-

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standing of relationships between water-based recreation and water quality.

THE BACTERIA PROBLEM

Bacterial contamination of recreational waters from local recreation sewage disposal facilities has become a critical consideration in Arizona. Efficient centralized waste collection and treatment systems supplant individual disposal facilities only at a very few recreation sites. Sewage disposal for the majority of sites is generally by septic tank -- leach field systems, pit privies or sealed vault toilets. When properly located, installed and maintained, these disposal facilities can provide adequate service for various use situations; but their misapplication at water-based recreation sites can lead to intolerable conditions with regard to aesthetics and public health (Hall & Sproul 1971).

Concern for public health has brought about the establishment of bacterial water quality standards in a number of areas around the nation. Approximately twenty-five states and territories have adopted fecal coliform bacteria health standards for primary contact recreation waters (i.e., bathing waters). These range from 1,000/colonies per 100 ml. for Mississippi, Tennessee and Georgia, to 70 colonies per 100 ml. for the Virgin Islands (U.S. Environmental Protection Agency 1972). Secondary contact waters generally have less stringent standards that are even more variable than those for primary contact. Inconsistancies of recreation water quality standards reflect the uncertainties various health and management agencies have concerning probable pathogen[3/] concentrations in relation to fecal coliform bacteria concentrations.

Field data from numerous freshwater and estuarine pollution studies indicate a sharp increase in the frequency of the common pathogen Salmonella when fecal coliform densities are above 200 organisms per 100 ml. (Geldreich 1970). The National Technical Advisory Committee of the Federal Water Pollution Control Administration recommends that for primary contact recreation, "the fecal coliform content . . . shall not exceed a log mean of 200/100 ml. nor shall more than 10 percent of the total samples during any 30-day period exceed 400/100 ml." (Federal Water Pollution Control Administration 1968). This standard is now gaining wider acceptance nationally, and has been adopted by the Arizona Water Quality Control Council (1968).

Arizona's bacteria standard for waters other than primary contact states the fecal coliform value, "shall not exceed log mean of 1,000/100 ml. nor shall more than 10 percent of the samples taken during any 30-day period exceed 2,000/100 ml." (Arizona WQCC 1968). The probable presence of pathogens in water containing particular densities of fecal bacteria, and the relative risk to users involved in secondary contact activities, are the basis for this fecal coliform bacteria standard.

Seventy percent of Arizona is under Federal ownership; twelve percent is State owned, resulting in 83 percent of the State territory controlled through public agencies (Arizona Statistical Review 1974). Recreation water resources that fall within varying public domains often have limited or no formalized approach toward water quality analyses of recreation impacts. Surface water quality within the State is highly variable and is a function of time, location, and flow patterns. Consequently application of generalized statements regarding water quality conditions within the State may not be representative and caution must proceed interpretation of average values depicting water quality parameters (Arizona State Water Plan 1975). Yet land managers must rely on limited water quality reasearch to develop management controls for recreation waters.

THE NUTRIENT PROBLEM

Of additional concern to water-based recreation land management agencies in Arizona are possible nutrient inputs from recreation users and facilities. Interest in this area is based on eutrophication processes, as eutrophication can be greatly accelerated by man-associated pollution.

Lake eutrophication often results in an increase in algae and rooted weed nuisances. Large masses of algae can cause a reduction in the aesthetic enjoyment of a water body. Wind action frequently causes floating masses of algae to accumulate along shorelines with other floating and rooted plants. This type of situation makes fishing and boating difficult while discouraging swimming and other water contact sports. When algae cells and rooted plants die, oxygen is used in decomposition and in some cases fish kills result (Mackenthum and Ingram, 1964). Rapid decomposition of dense plant growth, along with associated organisms and debris, may occassionally give rise to odors and hydrogen

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[3/] Organisms capable of eliciting disease symptoms in other organisms. Common pathogens include strains of Salmonella, Shigella, Leptospira and enteropathogenic Escherichia coli.

sulfide gass causing strong user disapproval (Hall and Sproul 1971).

Present knowledge indicates two of the fertilizing groups most responsible for eutrophication are compounds of nitrogen and phosphorous (Mackenthum, 1968). Nutrient concentrations in a water body of 0.01 ppm inorganic phosphorous and 0.30 ppm inorganic nitrogen are ample quantities to support nuisance algal blooms at the beginning of the active growing season; other environmental factors being favorable (Sawyer, 1952 and 1954). Nitrogen and phosphorous inputs from isolated sewage facilities as septic tanks, vault toilets and earthen pit privies might be the most prevalent sources of these nutrients at second home areas, camping areas and day-use sites. However, all non-human nutrient sources must also be considered in pollution determinations. Natural causes generating high nutrient concentrations might include precipitation, runoff, ground water, bottom sediments, decomposing plant and animal material parent material and soils. Nitrogen and phosphorous compounds contributed by transient water fowl, falling tree leaves and ground water may be important additions to recreation site nutrient budgets.

RELATED RESEARCH

At this writing only a small number of intensive studies have been conducted in Arizona that relate directly to the issue of water-based recreation and water quality. Two research examples conducted in 1970 and 1974 will be discussed in a condensed form. A third study, conducted by the authors in 1973 and sponsored by the Eisenhower Consortium, will be discussed in more detail. Three on going studies will be briefly mentioned identifying their location and purpose.

Obr, Follett and Kracht (1970) conducted a two year study designed to evaluate the effects of recreational use and development on water quality of Oak Creek Canyon, in Central Arizona. This study was initiated in February 1968 following concern over increased recreation use along Oak Creek Canyon with summer homes, cabins, resort lodges, campgrounds and picnic sites located on the immediate edge of the stream. Bacteria and nutrient sampling schedules of moderate intensity were established with sampling points located at high-use areas along a twelve mile reach of Oak Creek. Data evaluation resulted in a general conclusion that described the overall water quality as good. The authors did indicate, however, that pollutants, particularly fecal contamination, were becoming evident in the creek; contamination was attributed to failing septic tank-leachfield systems. Obr et al. determined this contamination would increase with the passage of time unless corrective measures were taken.

Specific study conclusions included:

1. Recreational use and activity for short periods of time had a marked effect on the bacteriological quality of Oak Creek. Bacterial degradation was evident during summer weekends, particularly on holiday weekends.

2. Only minimal increases in the concentration of nutrient parameters were detected between the upper and lower sampling points.

3. The geology of the area is not conducive to efficient use of septic tank - leach field sewage disposal systems due to shallow bedrock surfaces and low permeability soils.

The basic study recommendation suggested that one or more common waste collection and treatment facilities should be installed to service the populated areas along Oak Creek. Of major importance was the determination that such a system was essential to preservation of the area's recreational values.

Horak (1974) conducted a bacterial water quality study on the Acacia swimming area of Canyon Lake. This large impoundment is one of several located along the Salt River east of Phoenix, Arizona. Canyon Lake is used primarily as a swimming, boating and water skiing area. Horak's investigation was preliminary in nature and consisted of several sampling periods over each of two summer seasons, 1973 and 1974. Procedures included the extraction of water and sediment samples, and laboratory analyses to determine fecal coliform and fecal streptococci bacteria concentrations.

Although data were inconclusive it was hypothesized that the major intermediate source of the low to moderate fecal contamination detected was sediment stored bacteria. Human users and dogs were considered to be the ultimate sources. Recommendations included the prohibition of pets in the picnic and swimming areas. In addition, suggestions were made that motor boats should be restricted from operating near the swimming area as their propellers were capable of disturbing sediment at various depths. Disturbance and dispersion

of sediments was thought to promote the resuspension of sediment stored microorganisms.

Brickler and Utter (1975) examined the water quality issue in a study of three lakes and three streams in the White Mountains of east-central Arizona. A number of vacation homes, campgrounds and/or day-use sites were located proximate to all of the recreation waters in the area. These facilities and the large numbers of visitors frequenting the White Mountains during the summer months had become an obvious land management concern. Recognition of the situation brought about the development of the Brickler-Utter study in the summer of 1973, which was sponsored by the Eisenhower Consortium. Several major water quality parameters were investigated through field and laboratory analyses over the summer recreation season: (1) relative turbidity, (2) nutrient concentrations, and (3) fecal bacterial contamination.

Turbidity measurements and on-site observations showed no turbidity problems to be evident for the lakes and streams investigated. Potential erosion hazards were identified. Trampling and removal of vegetation from recreation activities began to expose considerable areas of surface soil at several recreation sites. Such conditions promote the movement of particulate matter into water bodies that could result in future turbidity related problems.

Nitrate nitrogen and orthophosphate concentrations (averaging 3.2 ppm and 0.10 ppm respectively) showed the project water bodies to be well enriched. Moderately eutrophic conditions were prevalent. Analyses indicated nutrient concentrations were due to natural rather than man related sources.

Although only minor fecal contamination problems were evident during the study some significant differences in contamination were identified between individual water bodies. Of the three lakes studies, the most heavily developed (although well within established EPA health standards) showed a significantly higher mean season concentration of fecal coliform colonies. The vast majority of fecal organism numbers responsible for this difference were isolated during a three-day period in mid-July, 1973. This short period of high fecal coliform bacterial counts (up to 800/100 ml.) coincided with the first storms of the summer rainy season.

Brickler and Utter cited an explanation by Geldreich et al. (1968) in which storm water was described as the major intermittant source of bacterial pollution that enters waterways. After precipitation comes in contact with the earth's surface contaminants are added from various sources. At the beginning of a rainfall event following a dry period of several weeks or more, bacterial concentrations may be very high in surface runoff. As the rain period continues the density of pollution decreases to original lower levels as a result of dilution.

Occurrence of this phenomenon at the most heavily developed lake of the White Mountains study was described as a watershed flushing effect (Kunkle and Melman 1967). In addition, the higher bacterial counts associated with this flushing effect were attributed to mixed human and animal contaminant sources on the watershed.

Two of the three streams studied showed little fecal contamination. One stream exhibited consistently high fecal coliform concentrations exceeding 600/100 ml. over the summer sampling period. Bacteria were determined to be more concentrated in this latter stream at least partially due to its lesser flow pattern and periodic cattle grazing along the narrow reach of the stream.

Although no major pollution problems were identified for the lakes and streams studied the authors concluded that the potential for major problems does exist if the expected future growth of water-based recreational use and development in the area continues. However, they felt this need not be the case should recreation land managers maintain a sensitivity toward possible pollution problems, develop a representative water quality monitoring program, remain aware of current water quality research developments, incorporate water quality research into budgeting, and perpetuate responsible recreation resource planning.

On going research conducted by Brickler, Phillips, and Motschall 1974-75 on recreational stream waters of Sabino Canyon recreation area of the Coronado National Forest was designed to examine water quality conditions along the 3 1/2 mile desert stream. Water samples were collected twice weekly in rotating time schedules of 8 AM, 12 noon, and 4 PM for 12 months from July 1974-July 1975. Specific sampling locations were determined based on representative recreation use, accessability and stream bottom condition. Surface waters, bottom sediments, and stir samples were tested for concentrations of fecal coliform, fecal streptococci and nitrogen and phosphorus. Preliminary analyses of the data show fecal coliform concentrations in surface waters ranged from 0 to 2624/100 ml. Fecal coliform concentrations in bottom sediments in most all cases exceeded those in overlying waters, with values ranging from 20 to 24,000/100 ml.

Fecal coliform concentrations in surface waters were highest during periods of intense recreation use. Preliminary analyses suggest that increases in fecal coliform concentrations in surface waters at certain points on the stream may be associated with the disturbance of bottom sediments by recreation activity as swimming and wading causing recirculation and redistribution of bacteria into surface waters (Van Donsel and Geldreich 1971).

A 12 month intensive water quality research is under way by Brickler, Phillips, Patterson and McKee of a perennial mountain stream transecting permanent and second home areas in the vicinity of Summerhaven on Mt. Lemmon, Coronado National Forest. Water quality parameters under examination are fecal coliform, fecal streptococci, suspended solids, BOD, COD, kieldahl nitrogen, total phosphorus, chlorine residual, temperature, flow and bottom sediments. Sewage from some homes is treated by a chlorinated holding-tank sewer system; the system discharges effluent directly into the stream. Frequent break down of the chlorinator has brought about closure of Marshall Gulch picnic area which lies directly downstream of Summerhaven, second homes, and the sewer system. Shallow soil conditions, exposed bed rock, and high water tables preclude adequate sewage treatment for some second homes not connected to the main sewer system. An early look at the data show high concentrations of fecal coliform and fecal streptococci in most all sampling stations. While not part of the initial water sampling parameters, high concentrations of Salmonella have been isolated below the sewage system.

Winslow 1975[4/] is currently conducting water quality research at Acacia Swimming area, Canyon Lake, duplicating and extending research initiated by Horak 1974. In addition to analyses of surface and bottom sediment for fecal coliform concentrations, Winslow is testing for the association of bottom sediment types, i.e., sand and silt mixtures, with fecal coliform concentrations. Data are pending completion of field research.

Water quality studies are underway by most USFS hydrologist in National Forest of Arizona. However, limited monies, insufficient number of personnel, lack of research facilities and large expanse of each forest create variability in sampling schedules. Consequently data in some cases may not be completely reliable or sufficient for land use planning and management of forest water resources.

[4/] Winslow, S. is a graduate research assistant, School of Renewable Natural Resources University of Arizona.

GUIDELINES OF CONTROL

Broad ranges of recreational and environmental use factors are directly related to recreational water quality. Because of the diversity of recreation patterns and areas, guidelines of control must consider the large variety of possible conditions under which pollution and other impacting may occur.

The quality of recreational lakes and streams is determined by natural and man related conditions affecting those waters and the watersheds on which they are located. Guidelines functioning to limit deterioration of water quality should apply to recreational use of the land and water as well as the physical, chemical and bacteriological character of the land and water. Each recreational activity demands individual considerations based on the activity's potential to deteriorate land or water conditions. Each local environment must be closely studied to determine the capacity to tolerate specific types and intensities of recreation use.

Guidelines of control given here are necessarily presented as general management considerations. Specific recreation areas and activities have individual problems which might require management action that would not be universally applicable. Hence, guidelines which guard against every possible negative impact from public use of water-based recreation areas might seriously limit relaxed use and enjoyment of an individual recreation site. The following guidelines are presented as broad precautionary measures dealing with conditions caused by overuse or improper use of water based recreation areas:

1. A basic philosophy of purpose, use and development should be established considering the environmental character and constraints of an area that would guide potential and expected uses of a recreation water and associated watershed.

2. Criteria should be established for determining the capacity of a recreation site to withstand the impact of recreation use and associated pollution.

   Based on these criteria and the philosophy of use, a plan of land-use controls should be drawn which would aid in facilitating an orderly pattern of development and use.

3. Appropriate soil conservation programs should be initiated to protect watersheds, shorelines and water quality.

   During periods when considerable and multiple land uses occur along land or stream perimeters efforts should be made to limit disturbance of soil and natural vegetation as surface water runoff, accelerated by loss of protective cover, may increase particulate matter entering receiving waters.

4. Intensive development programs should be dispersed over time instead of being permitted to occur simultaneously.

   Where adequate sewage systems or facilities have not yet been established, human fecal contamination may increase with the intensity of use and congestion of vacation homes and other developments. During the early years of development, fecal contamination factors may be much more significant if developments are allowed to concentrate in limited areas.

5. Lake development and recreational use areas should be located with respect to the tolerance of lakeshore lands and waters to absorb bacterial pollutants associated with these uses.

   For example, in shallow area coves where movement of water is restricted, circulation of fresh water may be limited during periods of summer stagnation. Runoff from lands surrounding these coves may carry bacterial waste into calm areas causing concentration of pollution. Conversely, runoff from points of land which extend out into a lake is usually dispersed around the border of the point and tends not to concentrate pollution. Waters surrounding points of land seem to be more subject to movement and to mixing with water from nearby deeper areas.

   Many factors of watershed topography, soils, length and degree of slope, and vegetational cover affect the tolerance of land for various kinds of recreational use. Those uses should be planned after careful consideration of land-use capabilities.

6. All direct bacterial and chemical pollution from garbage and refuse dumps, improperly constructed or maintained septic tanks, pit privies, unsealed marine toilets on boats, livestock and other related sources should be eliminated.

7. Close compliance with local, state and fedeal health and water regulations should be maintained to preclude pollution from recreational use and development. Where applicable, legislation should be tightened and improved to control higherto unrestricted pollution situations.

8. Programs of regular and systematic water quality analyses should be established to identify polluting situations or significant changes in bacterial, chemical or physical aspects of water quality.

CLOSING COMMENTS

Water quality research in Arizona directly related to the impact of recreation use and development on water bodies and stream is limited. Studies that have been completed, while meeting their specific purposes, are not sufficient in number or scope to represent the overall conditions of and recommendations for the State. Intensive and representative water quality research must be initiated if management controls are to confidently be applied and justified.

Monthly "grab samples" that are characteristic of water quality sampling programs by some public agencies will not accurately represent water conditions. Monthly analyses show the condition of the stream and water body at the time of the sample, and little else. Considerable caution should be exercised in drawing conclusions from 12 data sampling periods.

In order to maintain the quality of water-based recreation experiences, and to protect the value of the water resource, controls must be based on known parameters and standards, consistantly applied in the decision making process.

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Costs and Effectiveness of Selected Alternatives in Second-Home Waste Disposal Systems[1]

Kenneth B. Young and Mesbah U. Ahmed[2]/

A decision-making problem of designing a wastewater collection system, a central treatment plant and an irrigation system for utilizing treated effluent is analyzed for a second-home development project. A simulation model of the system operation is used to identify the least-cost alternatives in system design.

INTRODUCTION

Methods of wastewater disposal that are environmentally acceptable and which provide for beneficial re-use of effluent are attracting increasing attention in semi-arid regions of the southwestern states. Re-use of effluent can be expected to attain greater economic value over time as conventional sources of water supply become more restricted in these regions.

This paper discusses the use of a simulation model to conjunctively evaluate alternative methods of household wastewater collection, treatment and disposal via irrigation for a second-home development project. The model considers increases in effluent loading rates associated with additional development of the project over time and is designed to select the least cost combination of disposal facilities for specified environmental restrictions. Project growth rates and benefits accruing to the project owners are assumed to be related to improvements in sewage disposal facilities. A computer program for applying the simulation model to a selected second-home development area in West Texas has been developed but results of the application were not available for inclusion in this paper. Findings in this paper are limited to a comparison of costs for different components in the model and a tentative evaluation of the alternatives.

Disposal of sewage effluent via irrigation provides additional treatment by removing excess nutrients that are potentially damaging to the environment. Irrigated vegetation was estimated to have significant uptake of phosphorus and nitrogen in a Penn State Study (Sopper and Kardos, 1973). Golf courses have been irrigated with effluent without any measureable loss in soil productivity according to a California study (Sullivan, 1970). Use of effluent for irrigation in a state park has not caused any substantial or discernable change in groundwater or downstream surface water quality in a New Hampshire project (Frost, et al., 1973).

Conventional wastewater treatment plants are evaluated in a number of studies. Aggregate plant costs were reported by Schroepfer, (1939); and Rowan et al., (1960 and 1961). Separate cost analyses of treatment units relative to alternative effluent loading rates were made by Logan et al. (1962) and Frankel (1965). Problems of providing sanitary sewerage in intermediate population density areas and disadvantages of individual septic tanks have been investigated by Thomas et al., (1962).

Several studies have recently appeared on package treatment plants suitable for small communities (Goldstein, 1973), (Qasim et al., 1971, 1975), (Nicoll, 1971) and (Lamp, 1974). Package treatment plants offer important cost advantages over conventional plants for servicing small populations.

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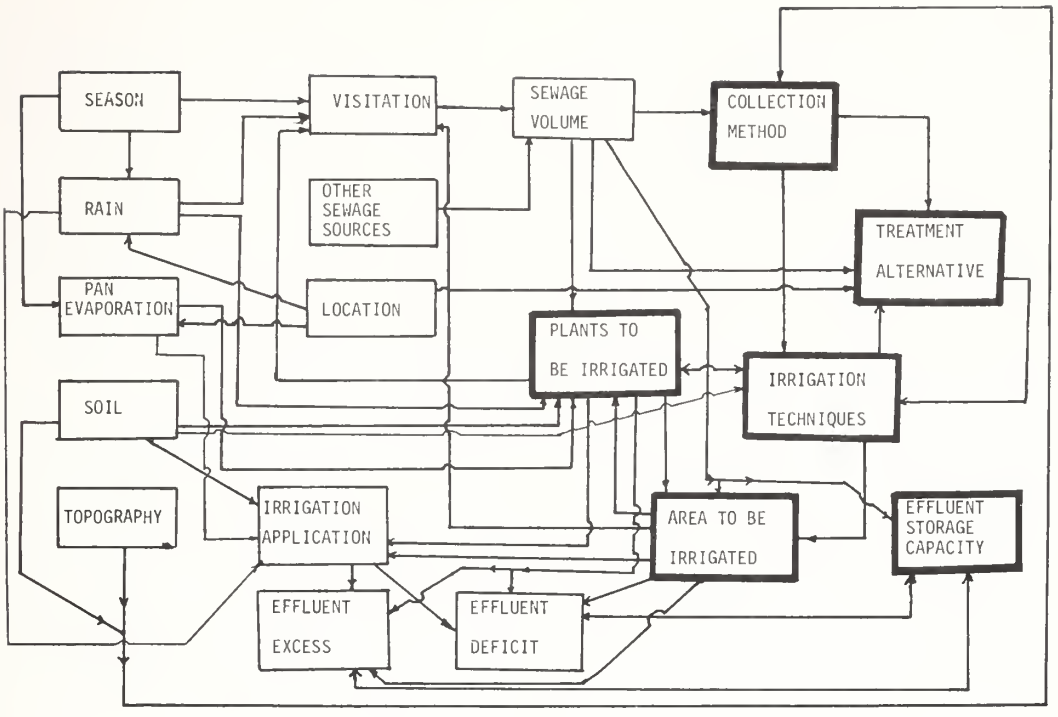

Fig. 1.-- Schematic diagram of the system.

A recent innovation in sewage collection systems is the use of grinder pumps and a low pressure conveyance system (Water and Sewage Works, 1973). This method can utilize smaller diameter pipe than conventional gravity flow systems and overcomes problems of land contours which are often encountered in second-home developments.

Although a relatively large volume of literature is available on different waste water treatment plants and on irrigation systems that utilize effluent, no specific studies appear to have been completed on a conjunctive system analysis of sewage collection, treatment and disposal via irrigation systems. One notable exception is a relatively broad engineering type study of wastewater treatment system design and operation for three alternative disposal methods: irrigation, overland flow and infiltration - percolation, recently completed by the Environmental Protection Agency (1973).

There are important economic interactions among various components of the system not evaluated in the above EPA study that merit attention. Treatment plant selection and location are conceivably affected by alternative beneficial uses for the effluent. Sanitary treatment requirements are affected by the method and location of effluent use, eg., proximity of effluent use to a municipal water supply and irrigation application rates for vegetation in the disposal area.

In areas where waste effluent has been used for irrigation, the typical method of application is either sprinkle or row irrigation. In the present study, sprinkle irrigation of shade trees and grassed areas on the second-home development site is compared to sub-irrigation methods. Sub-irrigation offers special advantages for public use areas in reducing vandalism, in being easily automated and in preventing direct public contact with treated effluent. The chief technical problem of sub-irrigation with drip systems is emitter plugging. However, plugging may be controlled to a large extent by filtration and acid flushing of lines to eliminate algae buildup (Read and Pietsch, 1974; Wilson, 1972; McElhoe and Tucker, 1974).

COMPONENTS OF MODEL

Basic components of the simulation model for evaluating waste disposal systems to service a second-home development project near a municipal water supply reservoir are illustrated in figure 1. This model is specifically designed to evaluate a particular lake recreation project with a combination of second-home development

and daily visitation to campground areas. The proposed irrigation facilities will be located primarily in campground areas.

Visitation to lake recreation areas is related to the season of the year and other factors including recreational facilities and distance to population centers (Grubb and Goodwin, 1968). Previous visitation records are used to project future visitation via regression analysis. The rate of change in annual visitation is assumed to increase with improvements in waste disposal facilities.

Volume of sewage varies with changes in daily visitation. In the case of the selected case study area there are restaurants, service stations and resident employees of the water treatment plant that account for a relatively stable component of waste water flow over the year. Predicted effluent flows are

$$(1)\quad S_{j,t} = \Sigma_i P_i V_{i,j,t} + S^o_{j,t}$$

Where $S_{j,t}$ = predicted volume of wastewater flow on the jth day of a given year, t; P_i = per capita wastewater coefficient value for the ith visitor category; $V_{i,j,t}$ = predicted visitation for the ith visitor category on the jth day for a prediction year, t; and $S^o_{j,t}$ = the estimated volume of wastewater flow provided by permanent lake residents on the jth day of a prediction year t. Treatment alternatives are affected by the type of irrigation system selected. For example, sub-irrigation methods require a high level of filtration but no chlorination treatment as compared to sprinkle irrigation.

Irrigation alternatives include sub-irrigation and sprinkle irrigation designs. Different sites with variable soil and slope characteristics affect the design of the irrigation system. On each site, there is a choice in plant spacing arrangements and in selection of plant species.

Relationships among various components in the model that affect the irrigation system including rain, pan evaporation, soil properties, topography, plant types, irrigation sites and irrigation system alternatives are depicted by the following equations. 3/

$$(2)\quad SM_{i,j} = SM_{i-1,j} + R_{i,j} - \Sigma_k N_{j,k} AE_{i,j,k}$$

$$(3)\quad AE_{i,j,k} = \left(\frac{SM_{i-1,j}}{W_j} \right) E_{i,j,k}$$

$$(4)\quad E_{i,j,k} = K_{i,j,k,} PE_i$$

Equations (2), (3) and (4) may be combined as follows:

$$(5)\quad SM_{i,j} = SM_{i-1,j} + R_{i,j} - PE_i \left(\frac{SM_{i-j,j}}{W_j} \right)$$

$$\Sigma_k K_{i,j,k} N_{j,k}$$

Where $Sm_{i,j}$ = available soil moisture on the ith day for jth type soil; $R_{i,j}$ = rainfall addition to soil moisture on the ith day for jth type soil; $N_{j,k}$ = size of irrigated area with jth type soil for kth type plant species; $AE_{i,j,k}$ = actual evapotranspiration on the ith day for jth type soil by kth type plants; W_j = water-holding capacity of jth type soil at field saturation; $E_{i,j,k}$ = potential evapotranspiration use on the ith day for jth type soil by kth type plants at field saturation; $K_{i,j,k}$ = consumptive use coefficient on the ith day for jth type soil by kth type plants; and PE_i = pan evaporation on the ith day. (Defined for i = 1,..., 365; j=1,...,N_1: k=1,...,N_2). Irrigated acreage for different soil sites and plant types is determined by the model. Soil moisture balance is kept within bounds by the following equations. 4/

$$(6)\quad I^{max}_{i,j,m} = \delta_{j,m} \Sigma_j (W_j - SM_{i,j})$$

$$(7)\quad I^{min}_{i,j,m} = \delta_{j,m} \Sigma j\ (a_{j,m} W_j - SM_{i,j})$$

Where $I^{max}_{i,j,m}$ = maximum irrigation level permitted on the ith day for jth type soil by the mth irrigation method; $\delta_{j,m}$ = irrigation application efficiency coefficient for jth type soil by the mth irrigation method; $I^{min}_{i,j,m}$ = minimum irrigation method; and $a_{j,m}$ = minimum percentage of water storage tolerated for jth type soil and mth irrigation method. (Defined for i=1,...,365; j=1,...,N_1; m=1,...,N_3)

Operating rules are employed in the simulation model to dispose of excess treated effluent outside the system when storage facilities are full and to pump water from the lake for the irrigation system when effluent flows and the volume of stored effluent are insufficient to meet irrigation requirements. The rules are:

3/ Soil moisture balance relationships depicted in these equations are derived from Technical Irrigation Requirements, 1972; Holmes and Robertson, 1959 and 1963; Mapp;1972; and Texas Water Development Board, 1972.

4/ Soil moisture balance is maintained between field saturation and wilting point as defined in Technical Irrigation Requirements published by the State Soil Conservation Service in Texas.

$$(8)\quad D_i = E_i - \Sigma_{j,m} I^{max}_{i,j,m} - (SC - V_{i-1})\} \text{ if } E_i > [\Sigma_{j,m} I^{max}_{i,j,m} + (SC - V_{i-1})]$$

$$(9)\quad P_i = \Sigma_{j,m} I^{min}_{i,j,m} - (E_i + V_{i-1}) \text{ if } E_i < [\Sigma_{j,m} I^{min}_{i,j,m} - V_{i-1}]$$

$$(10)\quad V_i = V_{i-1} + E_i - \Sigma_{j,m} I^{max}_{i,j,m} \text{ if } \Sigma_{j,m} I^{max}_{i,j,m} < E_i + V_{i-1} < \Sigma_{j,m} I^{max}_{i,j,m} + (SC - V_{i-1})$$

$$(11)\quad \Sigma_{j,m} I_{i,j,m} = E_i + V_{i-1} \text{ if } \Sigma_{j,m} I^{min}_{i,j,m} < E_i + V_{i-1} < \Sigma I^{max}_{j,m i,j,m}$$

Where D_i = disposal of excess treated effluent outside the system on the ith day; E_i = volume of treated effluent available for irrigation use on the ith day; SC = storage capacity for treated effluent in the holding tank; V_i = volume of treated effluent in storage on the ith day; and $I_{i,j,m}$ = irrigation application on the ith day for jth soil type by the mth irrigation method. (Defined for i=1,...,365; j=1,..., N_1; m=1,..., N_3).

In equation (8) the model will dispose of excess effluent, D_i, and apply the maximum irrigation level if the effluent supply exceeds the maximum permitted irrigation application level and available storage capacity for effluent. In equation (9) the model will pump lake water for irrigation and apply the minimum irrigation level if the minimum irrigation requirement is greater than effluent flow on the ith day and available stored effluent. In equation (10) the model is directed to apply the maximum permitted irrigation application level if effluent flow on the ith day is greater than the minimum irrigation requirement and sufficient stored effluent is available. In equation (11) the model is directed to apply an irrigation application equal to the sum of effluent flow on the ith day and avaiable stored effluent if effluent flow on the ith day exceeds the minimum irrigation requirement that day.

Disposal of excess effluent flows and pumpage from the lake are indirectly affected by soil types in the irrigated area and irrigation methods as indicated in equations (8) and (9). Sewage treatment plants are required to handle all effluent flow in the model, thus, eliminating the need for an untreated effluent storage facility.

THE DECISION PROCESS

Alternatives in sewage collection, in treatment plants and in irrigation systems for shade tree development are evaluated in the simulation model (Figure 1) according to the following decision rule.

$$(12)\quad \max [R(S_{jt}, I_p) - C_c + C_o + C_p]$$

$$(13)\quad C_c = f(S_{j,t}, P)$$

$$(14)\quad C_o = f(S_{j,t}, Q_p, T_o)$$

$$(15)\quad C_p = f(S_{j,t}, I_p)$$

Where $R(S_{j,t}, I_p)$ = present value of benefits associated with adopting a central treatment system to treat $S_{j,t}$ volume of effluent and using an irrigation system, I_p, to irrigate shade trees with effluent; C_c = present value of cost for the sewage collection system; C_o = present value of cost for the central sewage treatment plant; C_p = present value of cost for an irrigation system to service shade trees; $S_{j,t}$ = volume of wastewater flow on the jth day of year, t; T_o = the oth sewage treatment plant alternative; Q_p = effluent quality requirement of the pth irrigation plan alternative; P = physical characteristics of the area to be serviced by a sewage collection system that affect design (The design is governed by topography and location of collection areas relative to the central treatment plant); and I_p = the pth irrigation plan alternative.

In equation (15) costs of the irrigation system are also indirectly affected by other variables in the simulation model previously defined in equation (8), (9), (10), and (11).

APPLICATION OF MODEL

The study area selected for application of the conjunctive model for sewage collection, sewage treatment and irrigation system analysis is White River Lake, located approximately 45 miles west of Lubbock, Texas (Figure 2) The lake has a surface area of 2,400 acres and a capacity of 47,000 acre feet at full lake level. There are approximately 25 miles of shore line.

Primary use of White River Lake is municipal water supply. However, there is a shortage of water-based recreational areas in West Texas and this lake has high potential for recreational development because of its close proximity to a growing metropolitan area. Currently, there are about 270,000 daily visitors at the lake each year and 753 annual family use permits are sold for recreational use. The Water District has leased 253 lots for second-home development along the lake shore near the dam site (Figure 2) that are serviced by individual septic tank installations.

As determined in a previous soil survey (Blackstock and Neitsch, 1972) soils represented in septic tank drainage fields are relatively shallow with low permeability. The drainage fields generally slope steeply towards the lake.

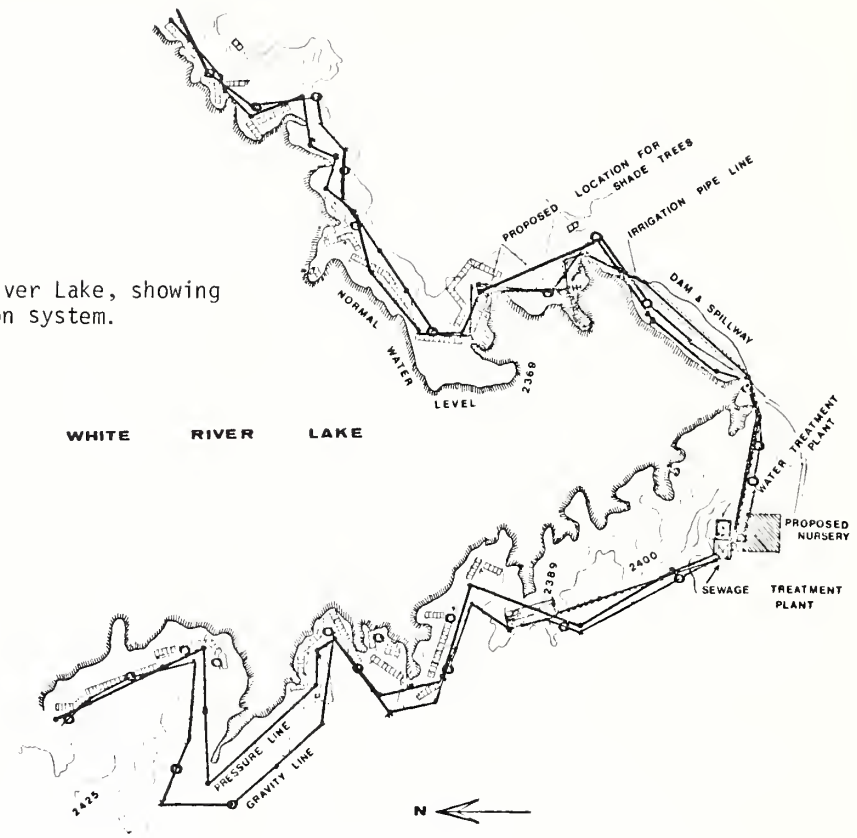

Fig. 2.-- Map of White River Lake, showing proposed sewage collection system.

Although no cases of septic tank pollution in the lake have been reported, there appears to be a potential problem in continuing development of second homes without adopting a common wastewater collection and treatment system.

The area surrounding White River Lake is currently barren except for scattered mesquite bushes. Most day campers are required to use some form of canopy to obtain shade.

As indicated in Figure 2 the water treatment plant is located near the dam site. The proposed site for a central sewage treatment plant is near the water treatment plant which is approximately midway in distance from lot development on both sides of the lake.

Alternative sewage collection systems evaluated in this study are a conventional gravity flow system equipped with 26 lift stations and a pressurized collection system composed of grinder pumps and 5 booster pumps. Four alternative designs for a treatment plant are evaluated. Various alternatives in irrigation systems are evaluated over a 20-year time period with different projections on growth of daily visitation and second-home development.

In the applied simulation model, pan evaporation and rainfall are assumed to be exogenous stochastic variables. No correlation between these two variables was assumed as indicated by a Modified Spearman Rho test (Conover, 1971). As these two variables were assumed to have independent probability distributions, characteristics of the two distributions were examined in the study area.

Statistical tests of the distribution of pan evaporation data including various tests for normality indicated that this distribution is positively skewed. A gamma distribution function was fitted to the pan evaporation data as characteristics of this distribution were verified by the Kolmogorov-Smirnov test. The gamma distribution function will be used to generate pan evaporation data input in the applied simulation model.

Periods of daily rainfall were assumed nonrandom as determined by the Wald-Wolfonitz run test (Conover, 1971). A conditional probability transition matrix was developed to generate rainfall input data in the applied simulation model where the conditional probabilities for daily rainfall periods are related to prior period rainfall conditions.

TENTATIVE RESULTS

Visitation

Daily visitation was projected for White River Lake on the basis of known daily visitor permit sales from 1969 to 1975. The following

Table 1. Average Contruction Operation and Maintenance Costs of Sewage Treatment Plants With Alternative Loading Rates

Type of Plant	0.06 MGD		0.1 MGD		1.0 MGD		10. MGD	
	Const.[a]	O & M	Const.[a]	O & M	Const.[a]	O & M	Const.[a]	O & M
	$000/MGD							
1. Package Plants[b]								
a) Contact Stabilization and Extended Aeration	858.9	125.0	719.9	85.0	n.a.[c]	n.a.[c]	n.a.[c]	n.a.[c]
2. Conventional Plants								
a) High Rate Trickling Filter[d]	2408.1	88.3	1998.2	74.4	870.9	34.5	386.6	16.2
b) Std. Rate Trickling Filter[d]	1807.1	84.0	1514.1	70.4	725.7	32.6	386.4	15.6
c) Activated Sludge[e]	1980.9	102.4	1593.8	89.8	908.1	49.7	518.8	27.5
d) Stabilization Pond[f]	573.5	19.0	316.3	15.1	174.6	5.4	72.9	1.9

[a] Construction cost estimates are for December 1974 and are based on the WPC-STP index for Dallas, Texas; 198.24. Operation and maintenance costs are for December 1974 and are based on U.S. Department of Labor Average Earnings for non-supervisory workers in water, stream and sanitary systems.

[b] Construction costs were estimated by a method reported by G.E. Lamp (1974). Operation and maintenance costs were estimated by a method reported by S.R. Qasim and A.K. Shah (1975). Data were also obtained from Hicks and Ragland (Consulting Engineers), Lubbock, Texas and from various manufacturers or distributors of package plant equipment.

[c] Not applicable.

[d] Based on methods by Shah and Reid (1970), Logan et.al. (1962) and R. L. Michael (1970).

[e] Based on methods reported by Shah and Reid (1970), Logan et.al. (1962), U.S. Department of Health and Welfare (1964), and R. L. Michael (1970).

[f] Based on methods reported by Shah and Reid (1970), U.S. Department of Health and Welfare (1964) and R. L. Michael (1970).

linear model provided an annual estimate of growth in daily visitation:

$$Y_t = 70,360 + 2,756X_t \quad (R^2 = .91)$$

Where Y_t = total permit sales; and X_t = number of years from the beginning of base year 1969. Actual total daily visitation was estimated to be 300 percent of Y_t by the Water District Manager as children and all local residents of the Water District are not required to purchase daily permits. This visitation figure excludes visitors who purchase annual permits.

Installation of a central sewage treatment facility would safeguard the quality of municipal water supply in White River Lake and permit expansion in second-home development. On the other hand, the availability of treated sewage effluent for irrigating shade trees in the currently barren camping areas would greatly enhance the environment for recreation at White River Lake which should promote more daily visitation.

With the proposed qualitative changes in the study area, it was assumed that more rapid growth in daily visitation and leasing activity for second-home development would take place. However, reliable data from other projects where similar improvements had been introduced were not available to estimate the effects on growth at White River Lake. As these effects could not be quantified, alternative increases in daily visitation and home development are assumed in the analysis to estimate benefits of qualitative improvements.

The number of second homes assumed in the evaluation of benefits are 252, 352, 452, 552, 652, and 752 second homes. Annual lease rates

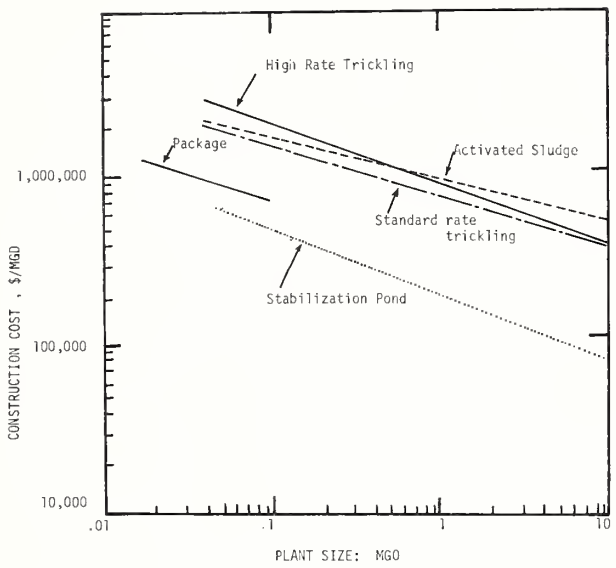

Fig. 3.-- Construction cost per mgd for different treatment alternatives, adjusted to Dec. 1974.

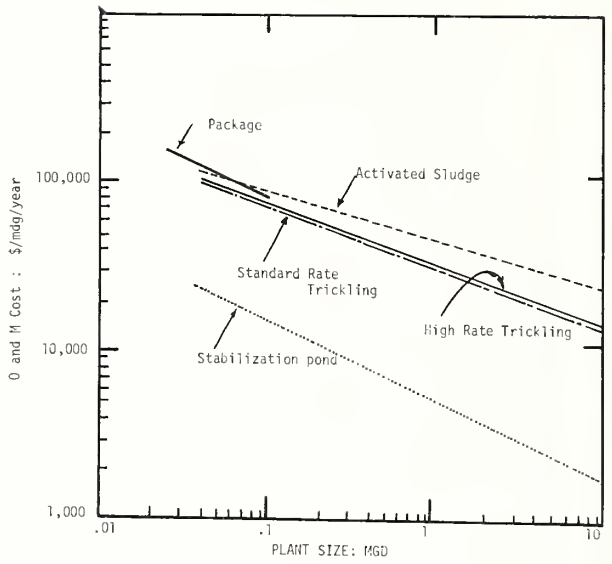

Fig. 4.-- Annual operation and maintenance costs per mgd for different plants, adjusted to Dec. 1974.

currently charged by the Water District are $100.00 per lot. Daily visitation permit sales are projected to increase by 2,756 per year as estimated in the regression analysis of previous daily permit sales at White River Lake. Sales of daily permits are assumed to increase at alternative rates of 2,4,6,8 and 10 percent per year above the current rate estimated by regression analysis following the provision of irrigated shade trees in camping areas at White River Lake. The price currently charged for daily visitation permits is $1.00 per day on weekdays and $1.50 per day on weekends. Additional charges are made for overnight camping and boat use.

Sewage Treatment Costs

Estimated construction, operation and maintenance costs of selected sewage treatment plants with alternative loading rates are shown in Table 1. Contact stabilization and extended aeration type package plants were estimated to have comparable costs and are therefore combined in Table 1. Package plants are not designed to handle loading rates above 0.1 mgd. The stabilization pond method was the least expensive facility for all loading rates. The activated sludge method was the most costly facility for effluent loading rates above 0.1 mgd.

Relative costs of different treatment facilities are illustrated in Figures 3 and 4. Package plants have somewhat higher initial construction costs than stabilization ponds for loading rates between .01 and 1.0 mgd. Stabilization ponds have much lower operation and maintenance costs at all loading rates. However, stabilization ponds have undesirable side-effects for use in a recreational area like White River Lake. They entail possible odor problems and may be ineffective under heavy rainfall conditions. These disadvantages will be given further consideration in the computer model application to White River Lake.

Sewage Collection Costs

Because of the rough terrain surrounding White River Lake, a pressurized sewage collection system utilizing grinder pumps and small diameter pipe can be installed at lower cost than a conventional gravity flow collection system for loading rates below 0.162 mgd. Investment cost for a .058 mgd. pressurized system is estimated at $200,000 (fig. 5) and increases at a linear rate to $300,000 for a 0.1 mgd. system. The increased costs are for additional grinder pumps and lateral line connections, assuming that further second-home development is located adjacent to the existing development. Conventional gravity flow collection systems can be installed at less cost than a pressurized collection system for loading rates above 0.162 mgd. (fig. 5) provided that the increase in second-home development is located adjacent to existing development.

Relative costs of the two sewage collection systems are compared in Table 2 for different effluent loading rates projected for White River Lake. Pressurized systems have the lowest installation costs for the probable level of development in the 1975 to 1995 period.

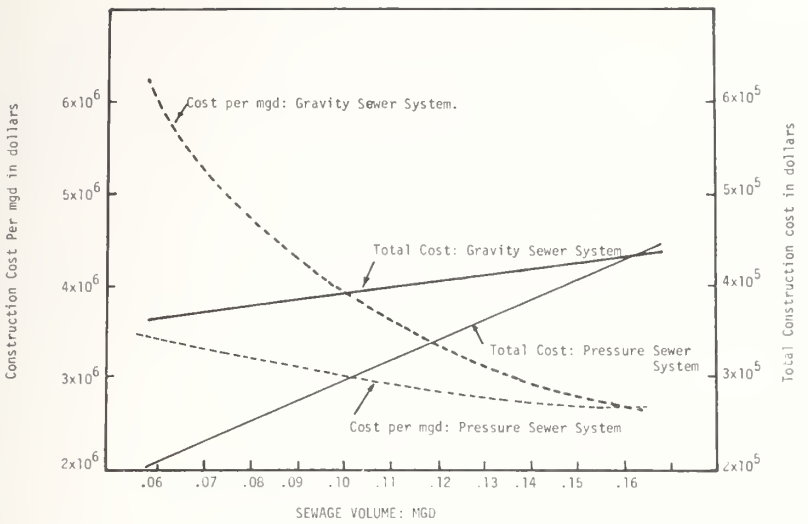

Fig. 5.-- Comparative construction costs of gravity and pressure sewer systems.

Irrigation System Costs

Installation costs for alternative irrigation systems and different irrigated acreage are shown in Table 3 and Figure 6. Cost estimates do not include main supply lines from sources of effluent. With comparable line spacing the automated solid set sprinkler systems have higher installation cost than automated sub-irrigation systems. Narrow-row spacing is required with the submatic system for irrigating solid grass cover. However, even with three-foot spacing the submatic system can be installed at less cost than the automated solid-set sprinkler system if the irrigated area exceeds five acres. Installation costs decline for all irrigation

TABLE 2. Alternative Projections of the Rate of Increase in Second Home Development and Daily Visitation With Associated Increase in Effluent Loading Rate

NUMBER OF UNITS IN SECOND-HOME DEVELOPMENT	PERCENT INCREASE IN DAILY VISITATION FROM 1975-1995 ABOVE PREDICTED VALUE	MAXIMUM DAILY VOLUME OF SEWAGE TO BE COLLECTED (MILLION GALLONS/DAY)	PRESSURIZED SYSTEM [a] / TOTAL COST/ COST	MGD	GRAVITY SYSTEM [a] / TOTAL COST/ COST	MGD
252	0.00	0.0582	$201.4	$3460.3	$362.9	$6234.7
352	39.68	0.0781	254.3	3256.4	376.9	4825.2
452	79.36	0.0980	297.2	3033.2	390.8	3989.0
552	119.58	0.1179	340.1	2885.3	404.9	3434.9
652	158.72	0.1377	382.9	2780.1	418.9	3040.8
752	198.40	0.1576	425.8	2701.4	432.9	2746.0

[a] / Cost in $ 1000 units

TABLE 3 - Installation Costs for Solid-set Sprinkler and Submatic Irrigation Systems.[a/]

IRRIGATION TECHNIQUES	Total Area Irrigated (Acres)			
	5	10	20	30
	Cost/Acre	Cost/Acre	Cost/Acre	Cost/Acre
Sprinkler Automated 40' X 40' Spacing	$1638.	$1561.	$1512.	$1460.
Sprinkler Manual	956	930	898	870
Submatic: Automated 40' X 40' Spacing	1070	610	380.	303
Submatic: Automated 30' X 30' Spacing	1120	660	430.	353
Submatic: Automated 20' X 20' Spacing	1170	710	480	403
Submatic: Automated 5' X 5'	1720	1260	1030	953
Submatic: Automated 3' X 3'	1870	1410	1180	1103

[a] The cost for pipe connecting the effluent storage and the supply point to the irrigation site is not included. The estimate includes costs for laterals, submains, pumps, motors, filtering systems, and flushing systems, proportioner and control stations along with other costs for electric connections, fitting and housing. The system has been designed for 40 gpm effluent.

Ref: Mr. Lawrence: Redi Rain Inc., Lubbock
Mr. Dale Bown: Submatic Inc., Lubbock

systems with increases in line spacing and total irrigated acreage.

Automated submatic systems have advantages other than lower installation cost in being completely located underground and in being more efficient in water use. On the other hand, sprinkler systems have a longer life and entail less technical operation problems than submatic systems.

Benefits of Proposed Development

Data were not available to evaluate direct quantitative benefits of providing a central waste water treatment facility and planting shade trees for use by daily visitors at White River Lake. Shade trees have been valued in other studies at ten dollars per square inch of cross-sectional area (International Shade Tree Conference, 1973).

In this study, benefits are measured in terms of lease revenue to the Water District for second-home building lots and in terms of increased revenue from the sale of daily visitor permits. Alternative projections in the growth rate of daily visitation and second-home development are used to value benefits.

Optimum combinations of development facilities as determined from use of the system simulation model were not available in time to report in this paper. The model is now being evaluated on a digital computer and more specific results should be available for the final report on this research project for the Forrest Service.

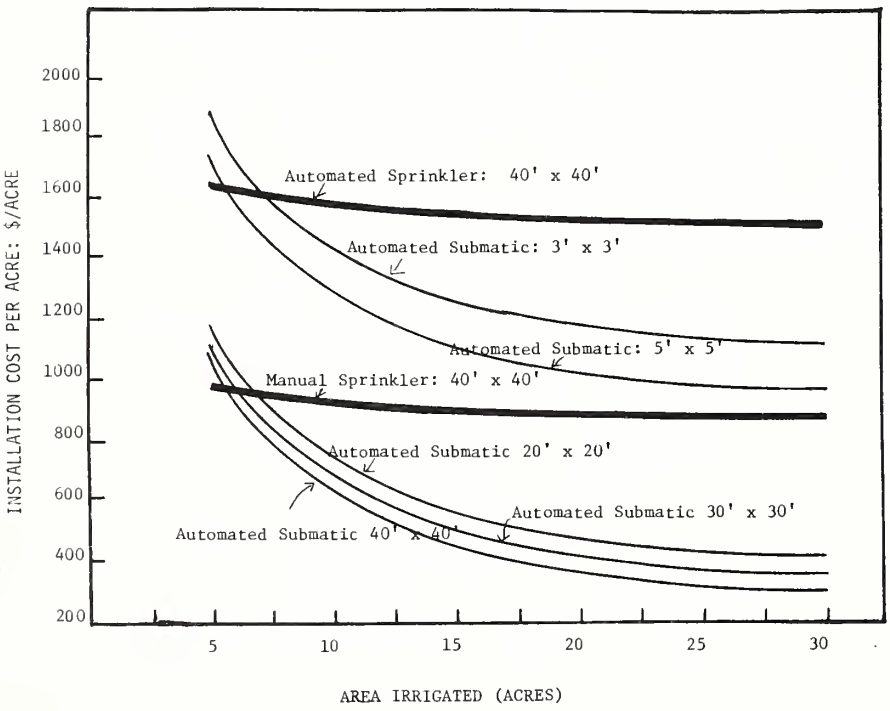

Fig. 6.-- Installation costs (dollars/acre) of irrigation systems.

The tentative indications are that stabilization ponds will not be an environmentally acceptable method of sewage treatment at White River Lake although much superior to individual septic tank installations. Package treatment plants are the next least-cost alternative. A pressurized sewage collection system is more economical than the conventional gravity flow method for the 20-year projected loading rate at White River Lake. Sub-irrigation systems are more economical and more acceptable from an environmental point of view than solid-set sprinkler systems for the study area.

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Evapotranspiration as an Alternative for Second Home Waste Disposal Systems[1]

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Abstract.--Evaluation of construction, operation, variations in wastewater loading rates and the efficiency of an evapotranspiration unit for waste disposal from a single family dwelling is evaluated to determine factors which affect the performance of the unit. The evapotranspiration process was found to be a feasible means for disposal of wastes from recreational homesites, particularly during the warmer months of the year.

INTRODUCTION

The increasing demand for mountain recreation and other second homes presents problems to many segments of our society. Part of the attraction of mountain areas are the unpolluted lakes and streams present in many of these areas. In addition, clean, cold mountain surface water and ground water may be used for water supplies at second home sites. Yet as development of recreational areas increases, the preservation and improvement of the environment has become of concern to planners, environmentalists, socioeconomists and industrial and commercial interests. Many second home developments provide inadequate or no means of handling human wastes generated at these sites. The end result may be a drastic deterioration in the natural beauty and recreational opportunities which attracted people to the sites in the first place. Goldstein (1973) estimated that in the United States some 30 percent of the population depends on septic tank and cesspool installations, outmoded privies or direct discharge to water courses for treatment of wastes. The use of these types of treatment facilities is the result of technology not paying attention to adequate treatment of wastes of single family dwellings such as second homes compared to central treatment systems developed for large communities. It is of paramount importance that means of treating wastes from single family dwellings be developed at a reasonable cost to the consumer which will not pollute surface or ground waters.

One possible alternative to presently available systems for wastewater treatment for single second home developments is the use of evapotranspiration. Evapotranspiration is the process by which water is evaporated and transpired from soil and plant surfaces. In this system the only outflow from the system results in water vapor and gases escaping into the atmosphere since the unit is completely sealed from surrounding soil by a membrane. Experimental work on evapotranspiration as a means of waste treatment has been carried out in Canada by Bernhart (1964). Witz, et. al. (1970) and Lubinus and Barker (1971) have discussed commercially available evapotranspiration systems for waste disposal. An evapotranspiration waste treatment method

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is presently under study by the authors for use with single family mountain recreational dwellings. This paper contains some of the results of research on this evapotranspiration (ET) unit and a discussion of its feasibility as a means of wastewater disposal.

THE EVAPOTRANSPIRATION UNIT

Location

The ET unit is located north of Larmie, Wyoming (fig. 1) at the site of the city waste treatment lagoons. The climate of Laramie is characterized by relatively low humidity (10-20 percent), mean wind speed of 5.0 miles per hour, mean annual rainfall of 11.1 inches, and mean annual temperature of 43° F with a range from -35° F to +93° F. The low mean annual temperature of Laramie is a result of its geographical location in southeastern Wyoming at an elevation of 7200 feet. The city itself is located on a high mountain plain which produces mainly short grasses and sagebrush. The site provided easy access to a source of wastewater and was in close proximity to laboratory facilities which were required for the study.

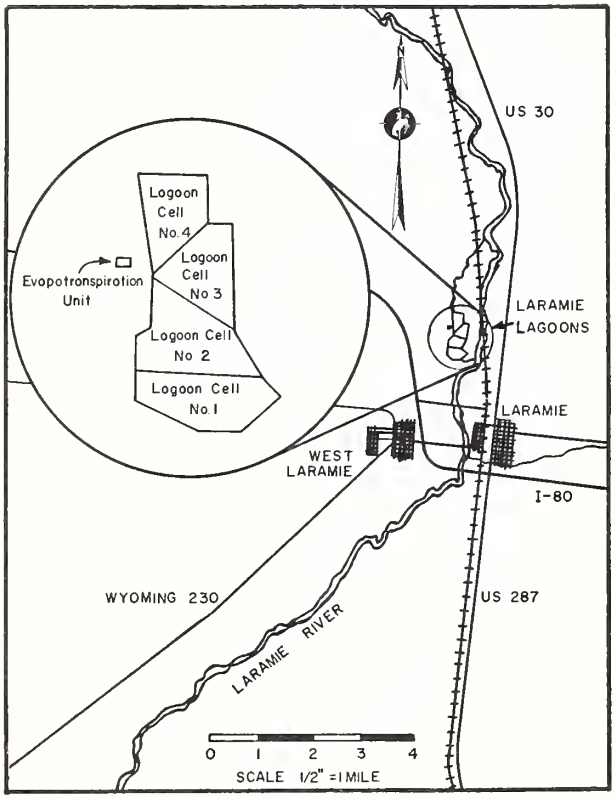

Figure 1.--The general location map showing the Laramie lagoons and the evapotranspiration unit with respect to the Laramie area.

Construction

Excavation and Backfill

The evapotranspiration unit consists of a rectangular trench approximately 30 feet wide by 40 feet long by five feet deep (fig. 2). The excavation equipment to be used will depend on the type of soil existing at the site. The soil material at the Laramie site was a clay loam top soil with a cobble-boulder-soil submaterial approximately two and one half feet below the surface resulting in the use of a front-end loader. The sides of the trench were made nearly vertical except for the side in which the front-end loader entered the excavation. The bottom was smoothed so that no sharp objects could penetrate or cut the membrane. The membrane seals the unit from any wastewater movement into the groundwater system, and as a result, there is no unit effluent as in septic tank, cesspool, and package plant treatment systems. The membrane is situated in the cavity so that at least 2 to 3 inches of liner are above the ground surface on all sides of the unit

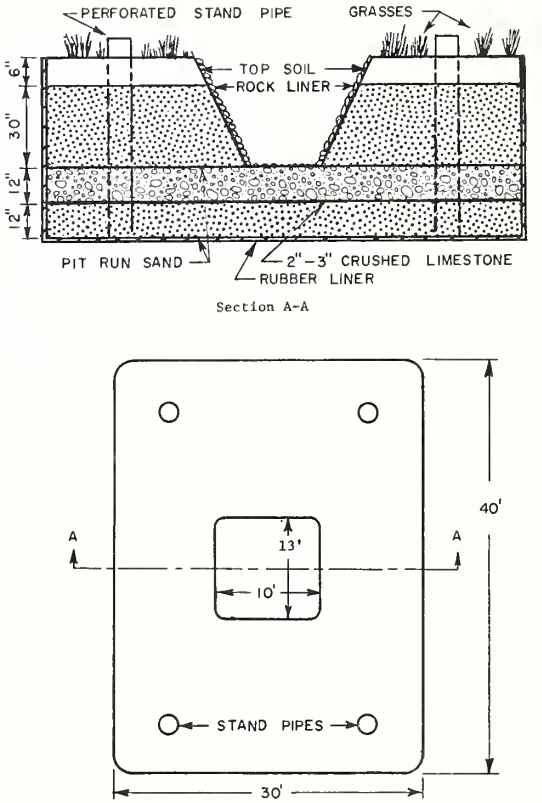

Figure 2.--A cross-sectional and plan view of the evapotranspiration unit.

ensuring a complete seal. A 22 millimeter thick nylon reinforced polyvinylchloride plastic was used for the membrane.

With the membrane in place, one foot of sand was placed in the excavation and smoothed into place by hand to ensure that the membrane was not punctured. After the sand layer was adequately shaped, one foot of two to three-inch rock was placed on the sand followed by 20 inches of sand and topped with six inches of topsoil. All layers above the bottom foot of sand were placed with the front-end loader. A ten foot by thirteen foot opening was formed in the center of the unit. The opening was lined with the two to three inch diameter rock. The main purpose of the opening is for entry of the influent wastewater, sampling, and observation. Four 4 inch perforated standpipes, which extended the full depth of the unit, were placed close to the corners of the unit for sampling purposes.

Sand and gravel materials were used as the filler for the unit to provide sufficiently large pore spaces to reduce the possibility of chemical, physical, and/or biological clogging (McGauhey and Winneberger, 1965; DeVries, 1972; Lance and Whisler, 1972; Thomas, et. al., 1972; Jones, 1965; and Rice, 1974). The rock layer helps to uniformly disperse the influent wastewater into the sand layers.

Grasses

A mixture of grasses which included tall fawn fescue, orchard grass, reed canary grass, and alfalfa was planted in the topsoil of the unit imediately upon completion of construction in August 1973. The selection of these grasses was based on representative types of grasses grown in the Laramie area, on varying root penetrations and on salt tolerance (Agriculture Handbook 60, 1954). A second seeding was performed in the Spring of 1974 since the stand of grass from the previous fall planting did not afford excellent coverage. By the fall of 1974 the unit was approximately 75 percent covered by grasses which consisted mainly of orchard grass, tall fawn fescue and reed canary grass. Alfalfa did not thrive in the wet condition of the soil which existed in the unit during most of the year while a number of native grasses from the area surrounding the ET unit have seeded themselves within the unit. At the present time (September, 1975) the unit is approximately 85 percent covered with grass and the grass stands from two to six feet in height.

It is important to plant a mixture of grasses on the unit so that those which can tolerate the conditions of the unit will flourish and grow. As the dissolved solids in the unit increase, it will be interesting to see the effect on plant growth and types of grasses which will survive under these conditions. At the present time, the grasses which are growing are not being affected by the dissolved solids content of the unit.

Operation and Loading

Untreated wastewater for the evapotranspiration unit is taken directly from a trunk sewer line and transported by truck to the unit where it is pumped into the center opening. The loading rate for the unit has been varied during the course of the investigation from a maximum amount of 2,000 gallons to a minimum of 500 gallons in a seven day period. During periods of inactive operation, little or no influent wastewater was added. Actual loading was done on a five day basis (Monday thru Friday) with no activity during weekends (Saturday and Sunday). The loading was then converted to an equivalent per person usage based on an average contribution per person of 50 gallons per day (Metcalf and Eddy, 1972) on a five day basis. From preliminary estimates of evapotranspiration which occur at Laramie during a typical summer, the unit as constructed was to accomodate a family of six people in a second home (i.e. 1500 gallons per week). The loading rates cited for the weekly periods were actual wastewater loading rates and as a result any precipitation which occurred during the same period of time is in addition to the amounts indicated.

During the units periods of active operation, a number of measurements were obtained at regular intervals. The liquid elevation was monitored in each of the standpipes located within the unit on a daily basis just prior to the injection of new influent wastewater. An elevation of 7200 feet was used as a base elevation for liquid level elevations. Data was also obtained to determine the effectiveness of the treatment process occurring within the unit. Samples of influent wastewater and effluent wastewater (that wastewater retained by the evapotranspiration unit which has not evaporated or transpired to that point in time) were taken on the same day on a regular basis (three to five times per week). The samples were tested for biochemical oxygen demand (BOD) coliforms, and solids (dissolved and suspended).

The operation and loading of the evapotranspiration unit during the late fall to early spring months occurred on a less than regular basis because of the lower amount of evapotranspiration and sublimation which occurs during this period as well as the thickness of ice and accessibility of the unit.

Factors Affecting Unit

The climate of Laramie as described indicates that it is a cool, windy, and arid area. To a great extent this characterizes many areas in the Western United States at higher elevations such as forested areas in the Rocky Mountains.

Evapotranspiration is dependent upon a number of quantities for its maximum functioning. The factors which most influence evapotranspiration are solar radiation, temperature (which is to some extent a function of elevation), relative humidity (vapor pressure), wind speed, soil moisture available, plant density, and surface area. A number of these quantities are interrelated such as wind speed and vapor pressure gradient which greatly influence evaporative movement. Since these quantities are greatly affected by geographic location, the Laramie site has particular advantages for such factors as solar radiation, wind speed and vapor pressure gradient. Soil moisture and surface area within the unit would be approximately the same at equivalent loading rates wherever the location. A disadvantage of the Laramie site is the relatively low mean annual temperature which affects the length of the growing season and as a result plant growth and density.

Esthetics are also an important factor with respect to the unit. Cover, odors, insects, algal growths and the like are all important in maintaining pleasing surroundings. These esthetic qualities were observed during the operation of the unit and under most situations it is believed that people would find the unit esthetically pleasing. Odors are usually not detectable. The grasses and the unit as a whole do, however, give such insects as mosquitos a hiding and perhaps breeding area (no larvae of any quantity has been observed).

RESULTS AND DISCUSSION

The principal objective of the study has been to obtain preliminary data that would demonstrate the feasability of evapotranspiration systems as a means of wastewater treatment for recreational homesites. While many variables come to mind which might be important in the design of an ET unit, the approach of the research has been to examine the behavior of a single unit over a period of time at several levels of application of wastewater. This allowed the variation in unit performance to be studied under a variety of environmental conditions.

The study has made a first step towards answering several pertinent questions. Is the ET treatment unit able to perform satisfactorily in a high altitude environment? How successful is the ET unit in bringing about beneficial changes in wastewater quality? What operational problems have to be considered before an ET unit is installed in a recreational setting? In addition, the study examined comparative costs involved in installing an ET unit and attempted to estimate the potential usable lifespan of an ET unit receiving semi-continuous applications of wastewater.

Feasibility

In order to determine the ability of the unit to perform under the conditions existing in Laramie, it was necessary first to determine the quantity of wastewater which could be applied to the unit without producing extremes of moisture levels in the root zones of the grasses on the unit surface. Prior to each application of wastewater, liquid elevation readings were taken from the four standpipes in the corners of the unit. As might be expected, the fluctuations in liquid elevations depended primarily on the wastewater loading being applied. During the initial startup of the unit in August 1973, 1,500 gallons of wastewater was applied to the unit per week with part of the influent wastewater to the unit being sprayed on the surface to encourage the germination and initial growth of the grasses. The liquid elevation rose gradually in the unit and reached a fairly steady liquid level 25 days after the beginning of liquid application to the unit. Application of the wastewater was discontinued in November when inclement weather made the unit inaccessible and the unit was left dormant over the winter period. Operation was begun again in late April, 1974 and a relatively stable liquid elevation was reached in the unit after a short period of time (fig. 3). When the liquid loading was decreased

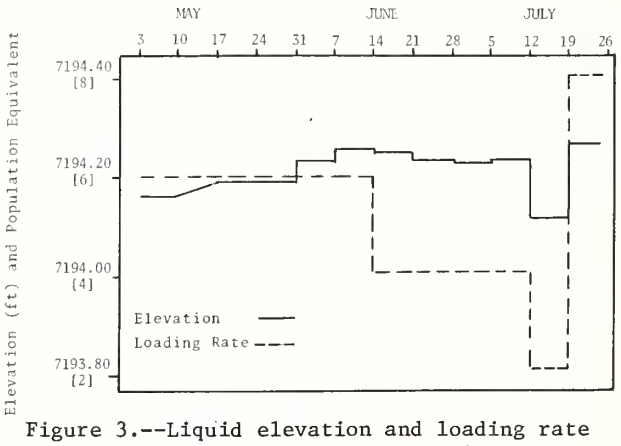

Figure 3.--Liquid elevation and loading rate of the ET unit during 1974.

to a population equivalent of 4 persons (1,000 gallons per week) approximately 25 days were required before the liquid elevation responded appreciably. However, when the liquid loading was increased to 8 persons (2,000 gallons per week), the liquid level rose rapidly and produced an overflow at one point at the side of the unit. Since loading at a population equivalent of 2 persons (500 gallons per week) was found to reduce the liquid elevation to a point below the grass root zone which could potentially result in damage to the plants, it would appear that the feasible loading rate for a unit of the size studied lies somewhere between 4 and 6 persons. The required surface area per person would be 200 to 300 square feet. Obviously, if the rate of evapotranspiration for any design location differs significantly from that prevailing at the Laramie site during the test period (approximately 0.3 inches per day), the application rate would have to be adjusted. Seasonal adjustments would also be required because during the October through April period in Laramie, the loading rate of the ET unit decreases to the point where the maximum loading possible is only 50 to 100 gallons of liquid waste per week. This is a result of frost which occurs during September and decreases the ability of the grasses to transpire and thus the ET units ability to evapotranspire the liquid water. The ET unit was completely iced over by December and thawing took place near the end of April. The thickness of the ice layer reached a maximum thickness during this period of 2.4 feet. The precipitation which occurs during this winter period also is a factor affecting the loading which can occur. The ET unit is therefore suitable for handling wastes during the summer but wintertime use of the unit may be handicapped in some locations.

Changes in Water Quality

During the test period samples of the applied wastewater and the liquid reaching the standpipes were analyzed to determine the ability of the unit to reduce the concentration of important wastewater constituents. The unit has no effluent as such, but it is important that the portions of the wastewater which can be broken down by the action of bacteria within the unit be degraded. Without some means of removing the degradable portions of the wastewater, these materials would accumulate and eventually cause the unit to become clogged and useless. The pores in the sand and gravel must be kept open to allow the liquid to move to the surface of the unit and be carried away by the evapotranspiration process.

Biochemical oxygen demand (BOD) is a measure of the oxygen required by bacteria to break down organic matter present in wastewater (i.e. carbon compounds). Thus, it may be regarded as an indirect measure of the organic matter present. Using recognized standard procedures, (A.P.H.A., 1972) the influent and standpipe liquid were analyzed for BOD substances. Removal varied considerably with time but did not appear to be related to the quantity of wastewater organic matter applied (fig. 4). This is an important point since many treatment systems are sensitive to hydraulic and organic overloading and will produce poor quality effluents when subjected to shock loads. Package biological

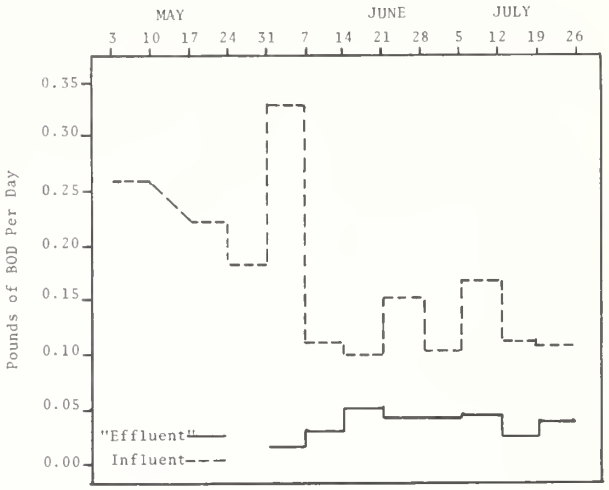

Figure 4.--Biochemical Oxygen Demand (BOD) for the influent and "effluent" wastewaters during 1974.

treatment plants in use at recreational sites in the Laramie area have shown considerable sensitivity to hydraulic and organic shock loads (Lindimore, 1975). Recreational sites generally produce wastewater erratically with considerable variation in the volume of wastewater generated and in the concentration of polluting substances. Insensitivity to shock loading is a definite advantage for recreational treatment systems.

Coliforms are a group of bacteria present in the intestine of warm blooded animals. Their presence in water is regarded as an indication that fecal contamination may have occurred and the water could possibly harbor disease producing agents. While removal of coliform organisms (fig. 5) varied over a wide range in the unit, removal rates were consistently above 90 percent and reached a maximum removal of 99.9 percent. The quality of the liquid reaching the standpipes would not be considered acceptable for recreational or

other purposes since the levels of coliforms remaining are still excessive. This is of no

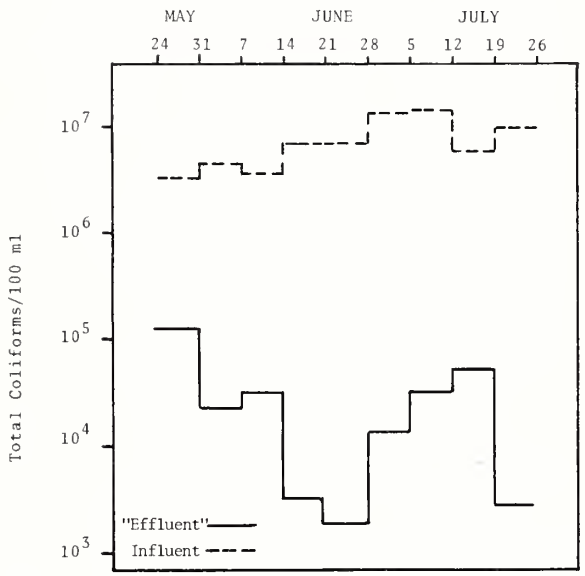

Figure 5.--Total coliforms measured in the influent and "effluent" wastewaters during 1974.

real importance in an ET unit since no effluent would escape the unit except under the unlikely failure of the liner. In an underground disposal system such as a septic tank system, however, the potential for contamination of ground water would exist. If the percolating wastewater reached a well supply, frequently used in recreational homes, a public health hazard could result.

Various types of solid materials are present in wastewater and may generally be divided into suspended and dissolved portions. Part of each category may be considered to be volatile, that is, it is made up of combustible or organic substances. Dissolved inorganic substances, principally salts, may combine with soil particles in such a way that the soil becomes less permeable to water (McGauhey and Winneberger, 1965; DeVries, 1972; Lance and Whisler, 1972 and Thomas, et. al., 1972). In an ET unit the salts present in the wastewater are left behind when the water leaves the unit by evapotranspiration and for the most part these salts will not be broken down by biological processes. As a result, salts tend to build up and may reduce the effective lifespan of the unit. Dissolved solids reaching the standpipes in 1973 were consistently above the influent levels. During 1974 (fig. 6) the salt being applied frequently was less than the concentration found at the standpipes, particularly during the periods when the hydraulic loading was reduced. This tended to indicate a rather constant migration of salt to all parts of the unit. An overall increase in salts at the standpipes of the unit has been observed, but no effects of a salt buildup, either on the ability of liquid to move through the unit or on the salt tolerant grasses growing on the unit surface have been noted.

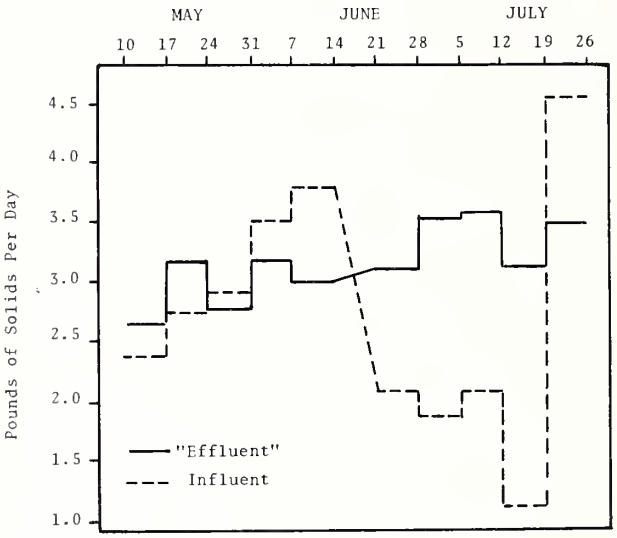

Figure 6.--Dissolved solids of the influent and "effluent" wastewaters during 1974.

Suspended solids are important because the particulates have a tendency to clog soil pores. With time, pores could become so thoroughly blinded as to render the unit useless unless the solids could be broken down. The volatile suspended solids represent the biodegradable portion of the suspended material. Total suspended solids (fig. 7) were removed fairly effectively by passage through the unit. Although effluent values occasionally rose above influent levels, no severe clogging problems were apparent. Volatile solids (fig. 8) were reduced from influent values, apparently due to biological activity in the soil within the ET unit. It would appear that the suspended solids would be reduced in part, at least, as biological action reduces the solids to gases and water. It is interesting to note that the volatile solids present in the unit at the beginning of 1974 were significantly less than levels observed at the end of operation in 1973, indicating that the removal of the organics continued during the winter months. Thus the unit has the capacity to renew itself when given rest periods. Since second homes are

not likely to be in use continuously over the entire year, rest periods would be an advantage of an ET system as long as the moisture available to the vegatative cover is sufficient to maintain growth.

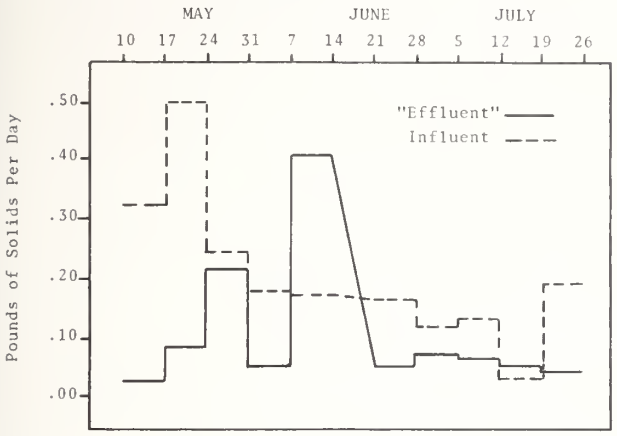

Figure 7.--Total suspended solids of the influent and "effluent" wastewaters during 1974.

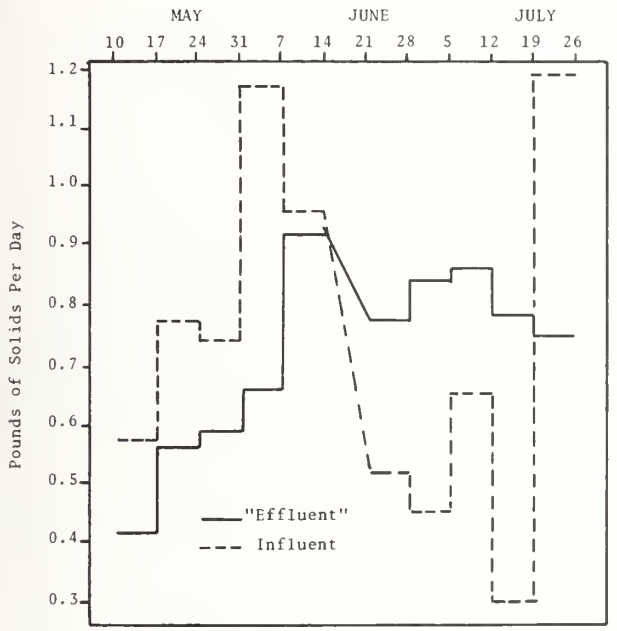

Figure 8.--Volatile solids of the influent and "effluent" wastewaters during 1974.

The major problem associated with the solids would appear to be salt build-up rather than accumulation of suspended solids. The sodium adsorption ratio (SAR) is used in irrigation water studys to determine the hazard of salt toxicity to plants and the possibility of the salts present causing changes in soil structure which would reduce the ability of the soil to transmit water through soil pores. Generally clay soils are more susceptable to damage than soils of low clay content. The ET unit construction would thus best meet long term needs if a sandy subsoil is used. The observed SAR for the Laramie ET unit was 2.75 meq/l at a specific conductance of 2200 micromhos per cm. SAR values of this magnitude indicate that the water has a high salinity hazard to plants but a low sodium hazard (Agriculture Handbook, 1954). Plants vary widely in their tolerance to salt. By judicious selection of salt resistant varieties the ability of the unit to withstand the applied salt may be increased. All grasses used in the Laramie unit have an ability to withstand salts far greater than the levels currently observed. The potential for damage to the plants does exist, however, and might require the backflushing of the unit with low salinity water in the future to leach salts out of the unit. In addition, one must consider the possible sensitivity of the bacterial population to salt buildup, although this is not likely to be a critical factor since many bacteria present will be derived from the human intestinal tract where a high salt content prevails.

Operational Problems

Operational problems associated with an ET unit are few in number. Since there is no effluent, the unit will meet the most rigorous interpretation of the 1985 "zero discharge" requirement of PL 92-500. The liner must be placed so that the edges extend well beyond the excavation prior to filling to prevent any discharge. The liner of the Laramie unit slipped below the ground level during a portion of 1974 and resulted in some leakage of wastewater. The integrity of a sufficiently tough liner should be maintained. This means that proper attention should be paid to construction techniques. The central opening used to dose the unit and store excess liquid could provide a breeding ground for flying insects and be a source of odor nuisances. However, observation of the unit indicated such problems were minimal. The influent to the Laramie ET unit required pumping into a central opening. It is possible that the opening could be eliminated entirely and replaced with an underground perforated pipe distribution system. This would eliminate some problems encountered during cold weather when the pit ices over. Costs would be increased, however, by increased piping requirements.

COST ANALYSIS

The costs of installing an ET unit like the one described in this paper is quite favorable. Treatment systems used to handle wastes from single family dwellings at the present time (i.e. septic tank and leach field arrangement) will be used for comparison.

The cost of a liner for an ET unit will run between $0.40 and $0.50 per square foot. Sand, gravel and topsoil will vary in cost depending on the natural meterial available at the site and haul distances involved. It may be quite practical to place much of the excavated material back into the trench where suitable material is involved. Costs will vary considerably for the backfill material but for discussion purposes assume $3.50 per cubic yard for backfill. Equipment and labor is another large variable which is hard to estimate because it depends on the site. Assuming two men and a loader or backhoe for one and one-half days to install the unit, the cost would be around $400. As an estimate, the ET unit described previously would cost $2,000 or less to install.

Most septic tank and leach field installations cost between $1,000 and $1,500 to install. Thus, the septic tank system is somewhat less expensive but the treatment and environmental protection afforded by the ET unit gives it a very favorable appeal within its own cost range.

SUMMARY

The use of evapotranspiration for treating wastewater from recreational homesites has been shown to be a feasible process. While efficiency of the ET unit is markedly decreased during the colder months, summer operation is both effective and capable of handling the fluctuating waste loads typical of recreational homesites. Since the unit has no effluent, the zero discharge requirement of PL92-500 will present no problems. Costs of installing an ET unit are comparable to other methods of single dwelling disposal.

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The Effects of Second Home and Related Vacation Development Use on Water Quality in Arizona[1]

Burton A. Segall[2]/

Abstract.--Two studies are reported that review the impact of second home use on water quality. Sewage flow rates are dependent primarily upon population in residence; pollutant concentrations compare with suburban community wastewaters. Utilizing the assimilative capacity of soil is proposed as the primary waste disposal method for second homes, in lieu of water disposal.

INTRODUCTION

The disposal of wastes from vacation-oriented communities that border national forest lands is a significant environment problem. Sewage discharged to water courses, with or without conventional treatment, can diminish water quality and restrict the use of water resources and contiguous forest areas.

The waste disposal problem is twofold in the southwestern United States. Wastewater that is not treated adequately or disposed of in an innocuous manner is aesthetically objectionable and a potential health hazard. But wastewaters and their nutrient constituents are valuable resources in water-short regions and can be utilized for plant growth, both within recreational communities and in the surrounding national forest.

Two field studies were undertaken in northern Arizona to determine the impact of second homes and related recreational development on surface and groundwater. The initial study was conducted at an established community of second homes that collects wastewaters in a sewerage system and treats waste materials in a conventional extended aeration sewage treatment plant. The second study was conducted in a national forest area that has been developed by the Forest Service for public camping and that also contains private home and trailer park developments. Septic tanks and leaching fields are used for waste disposal in this area.

This research was sponsored by the Eisenhower Consortium for Western Environmental Forestry Research and the United States Forest Service, Rocky Mountain Forest and Range Experiment Station under agreements 16-298-CA and 16-335-CA.

RECREATIONAL COMMUNITY WITH A SEWERAGE SYSTEM

The Pinewood subdivision at Munds Park, Arizona, is located 18 miles south of Flagstaff, Arizona, along the Black Canyon Highway. The community occupies 1,100 acres; 900 acres are allocated to home development and the remaining area is utilized for recreational purposes--primarily a golf course. The totally developed community shown in figure 1 will consist of 3200 homes on lot sizes averaging 70 feet x 100 feet. When this study was conducted, in August 1972, 80 percent of the total acreage available for home development had been sold but only 550 lots, or 17 percent of the available area was occupied. At present (August 1975), 30 percent of the home sites are occupied (950 lots). An average occupancy of 2.5 persons per dwelling was used for the study. This estimate is less than the average occupancy experienced in suburban communities in Arizona (about 3.2 persons per household). The low estimate reflects the transitory characteristic of a resort area population; i.e., we assumed less than the entire family in residence.

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[1]/Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

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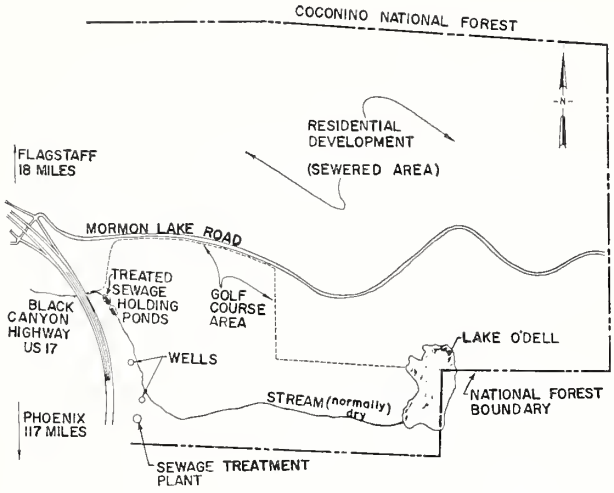

Figure 1.--Pinewood, Arizona.

The community's water supply source consists of two 200-foot-deep wells located at the edge of the golf course. The period of maximum water consumption occurs during the summer, July through August, when a majority of home owners are in residence. Only a small percentage of the water supplied to consumers at Pinewood is used for consumptive purposes, i.e., lawn watering, street washing, etc. Thus water use quantities, adjusted for leakage and the few homes and businesses that have septic tanks, are representative of sewage flow. Water consumption data indicated that about 10 percent of the population are year-round residents and more than half of the home-owners stay six months each year, although most of these people spend only weekends in Pinewood. The average total residence time is about 90 days per year.

Water consumption during the winter months averages 6 gallons per capita per day based upon the total community population or about 60 gpcd for the people in residence; i.e., about 10 percent of the Pinewood population are in residence during the winter months. During the peak flow month of August, per capita consumption averaged 44 gallons per day based upon the total population. Estimates of occupancy during the month of August vary from 50 to 80 percent.

The type and size of dwelling appears to have little influence upon wastewater quantities and characteristics at Pinewood. Mobile homes have as many bathrooms, kitchen and laundry facilities as the cabins and larger homes. With the exception of lawn sprinkler systems, the homes are as equipped with as many water-using facilities as an average home in a suburban development.

Sewage flow estimates were based upon extensive water consumption data and sewage flow charts available for July, August and September, 1972. Based upon the total home-owning population, daily sewage flows for this second home community are shown in Table 1.

Table 1.--Sewage Flow Rates

	Gallons per Capita per Day
Average Daily Flow (12-month basis)	7
Average Daily Flow (December through April)	4
Maximum Monthly Flow (August)	26
Maximum Day Flow	33
Peak Hour Flow	43

Daily, monthly and seasonal sewage flow variations are caused primarily by variations in the resident population, not variation in water use activities as is customary in suburban communities. The per capita discharge in August (26 gallons per day) is about half of the flow normally discharged by residential communities. A survey of Pinewood during the month of August also indicated that about half the homes were in use.

Variations in daily and hourly sewage flow rates during the summer are shown in figures 2 and 3. Weekend flows are 50 percent higher than mid-week rates. Hourly peaks occur at noon and at 9 p.m.

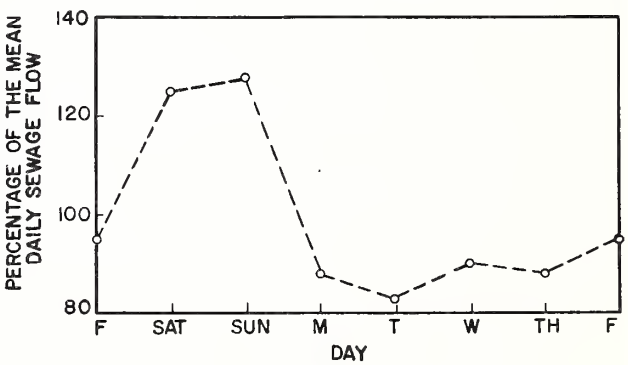

Figure 2.--Variation in daily sewage flow during August and September, 1972.

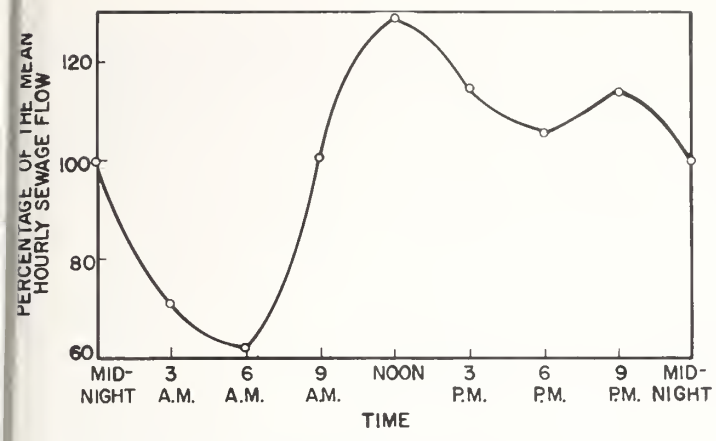

Figure 3.--Variation in hourly sewage flow during August and September, 1972.

Chemical and Bacterial Characteristics of Second Home Wastewater

Chemical and bacterial contaminant concentrations in Pinewood sewage are similar to values reported for residential communities. Increase of pollutants with domestic water use and typical values for residential communities are shown in Table 2.

Table 2.--Increase of pollutants with domestic water use.

Constituent	Concentration			
	Results of This Study		Typical Values for Residential Communities	
	mg/ℓ	lb/capita /day	mg/ℓ	lb/capita/day
Biochemical Oxygen Demand (5 day)	196	.095	200	.10
Organic & Ammonia Nitrogen as N	34	.016	30	.0145
Nitrates as N	0	.0	0	.0
Phosphates as P	10	.005	10-17	.006-.008
Alkalinity as $CaCO_3$	160	.08	100-150	.05-.08
Chlorides as Cl^-	30	.01	20-50	.01-.02
Coliform Group Organisms	MPN per 100 ml = 1.6×10^9			

Biochemical Oxygen Demand increased from zero in the potable water supply, to approximately 200 mg/liter in domestic sewage. Organic nitrogen and ammonia in sewage increased 30 mg/liter above nitrate nitrogen levels found in the water supply. Phosphates increased about 10 mg/liter above trace levels found in the water, and chlorides increased about 30 mg/liter.

Pinewood is served by a sewerage system that conveys wastes from homes to a package sewage treatment plant. The majority of the homes in Pinewood are built in areas where the soil mantle is too shallow and the plot size too small for individual soil waste disposal systems. The golf course is the only area capable of supporting subsurface waste disposal systems at this community.

The small treatment plant was designed for saturation population and under present loading conditions it normally functions exceedingly well--BOD reduction of 95 percent and better. Phosphorus and nitrogen are not significantly reduced in secondary treatment. The long detention time experienced under present loadings at Pinewood results in conversion of organic nitrogen and ammonia to nitrates, but in little reduction of total nitrogen. Chlorination reduces bacterial concentrations.

Package plants do an excellent job of reducing carbonaceous materials when loadings are relatively uniform and within the capacity of the particular plant. However, uniform sewage flow to small plants is the exception rather than the rule. This is particularly true at a second home development where resident population fluctuates widely on an hourly, daily, and seasonal basis. Plants frequently malfunction under these conditions. In addition, the operation and maintenance of small package plants varies in Arizona from good to occasionally allowing plants to operate themselves--which they do not.

Combining wastewater flows from many homes is in itself a most significant potential environmental hazard. A water reuse practice found frequently in the Southwest is utilized to eliminate the discharge of wastewater to the national forest surrounding Pinewood. Secondary effluent from the community's sewage treatment plant is used to water a golf course. The water and organic and nutrient materials present in the waste are utilized for plant growth. Contamination of groundwater underlying the golf course was investigated during the course of the study and no contamination was found.

RECREATIONAL DEVELOPMENT WITHOUT A SEWERAGE SYSTEM

Oak Creek Canyon lies just north of Arizona's magnificent red rock national monument at Sedona. The canyon is traversed by one of the few free flowing streams in the state and is heavily used as a summer recreational area. Privately owned homes, trailer parks and public campgrounds are located at many points along the stream (fig. 4). Sewage from homes

and trailer parks is disposed of through individual septic tanks; vaulted privies are used for waste disposal at public campgrounds.

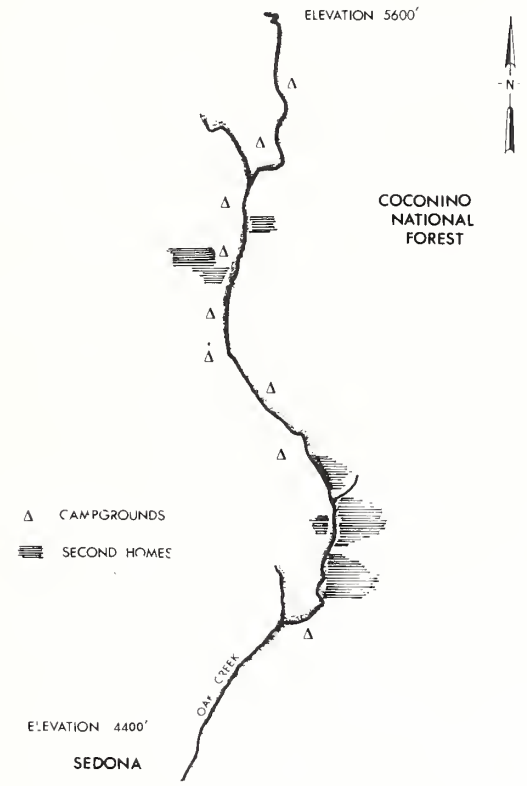

Figure 4.--Oak Creek Canyon

Adequate waste disposal either through the utilization of aquatic or soil systems involves the process of assimilation and the assimilative capacity of streams have traditionally been utilized by communities for sewage disposal. However, when a watercourse such as Oak Creek is used extensively for recreation, treated or untreated sewage contamination is a serious problem; utilizing the assimilative capacity of the stream is not desirable.

The earth's soil mantle is a traditional depository and treatment medium for domestic wastewaters and soil disposal systems offer an alternative to water disposal and consequent water pollution. Soil assimilation consists of numerous complex processes including entrapment of particles, absorption, biological decomposition and the food chains of plants.

Soil Waste Disposal

Percolation through soil is an effective method of removing many potential pollutants from domestic sewage. With sufficient residence time in the soil, organic material can be totally oxidized and bacteria and viruses effectively removed in relatively short distances. Metals, e.g., aluminum, copper, iron manganese, phosphorus and zinc, form insoluble compounds in soil and precipitate out. Other elements may be partially removed (calcium, magnesium, potassium and boron) or not removed at all (chlorides and sodium). Organic nitrogen is oxidized in soil to nitrates but long travel distances through soil are required to deplete nitrogen concentrations.

The size of soil particles, the nature of a soil mass, and rate of flow through soil are particularly important in preventing stream and ground water contamination. Soils and rock formations which permit rapid flow through fissures and crevices or underground channels can obviously carry waste materials considerable distances with little contaminant removal or treatment. Underground springs such as those encountered along Oak Creek can carry septic tank effluents rapidly to surface streams. This in effect diminishes the effective time available within the soil mass for waste assimilation.

Oxidation of organic materials in soil can vary from minimal amounts to virtually complete oxidation. For well designed septic tank systems in which adequate distances are maintained from surface and ground waters, organic materials normally do not contaminate water supplies. Oxidation processes in the soil are also enhanced by the typical intermittent use of recreational homes. Periodic dosing and recovery periods tend to increase the efficiency of the soil waste treatment process.

Soils in Oak Creek Canyon are coarse textured sand and loam. Soil depth is generally deep throughout the canyon except adjacent to the creek. Results of percolation tests and soils analyses indicate that, generally, soils in the canyon are suitable for subsurface sewage disposal systems except along the banks of the stream. Percolation rates vary from adequate to exceedingly rapid. However, high infiltration rates are not necessarily always desirable. The more rapidly water seeps through the soil the less opportunity there is for waste assimilation. This is a significant problem along Oak Creek where septic tanks and drainage fields are located in close proximity to the flowing stream.

The most desirable home and trailer locations in the canyon are along Oak Creek. Unfortunately, many of these sites are in outcrop areas and are not suitable for subsurface waste disposal systems. In years past, this had led to numerous illicit waste disposal practices

including direct discharge to Oak Creek, using wells for waste disposal, and poorly designed septic tank systems. This sort of practice has been eliminated by State Health Department licensing and inspection.

Chemical and Microbial Contamination of Oak Creek

In the traditional sense, Oak Creek is not polluted. Sewage flows are not observed along the banks of the creek; particulate materials, obnoxious odors, water discoloration, and algal blooms, the characteristics of gross pollution, are not observed within the canyon. Yet there are chemical and biological problems associated with existing wastewater disposal practices in the area.

Sewage may enter Oak Creek in a variety of ways. Swimmers and people fishing and camping along the stream or its tributaries are potential sources of pollution. Discharge of kitchen and bathroom wastes from campers constitutes a potential source of contamination. Septic tank systems that are improperly designed or illicit waste disposal systems that do not make use of the soil's capacity to assimilate wastes are yet other sources of pollution. All of these sources are intermittent in a resort area and are thus difficult to detect by periodic stream sampling and water analyses. Yet considering the extensive use of Oak Creek for swimming, these potential sources of pollution have public health significance.

Contamination by second home developments is suspected along Oak Creek, although sources of apparent direct sewage discharge to Oak Creek have been eliminated in recent years. The reasons for an assumption of periodic contamination include the following: (1) when most of the older second homes were built, design and installation of septic tank systems was loosely controlled by the county and state; (2) springs flow near the ground surface through a number of home developments and these developments have septic tank disposal systems; and (3) slime growths are observed along the banks of Oak Creek below homes.

Chemical and bacteriological examination of Oak Creek water were conducted during the summer of 1973 to determine the level of pollution in the stream and to find sources of stream contamination. Several factors were considered in selecting water characteristics for the study. Quality characteristics were required that are indicative of sewage pollution, that are not totally removed in percolation through the soil and that are relatively easy to test for at a field laboratory. Most sewage characteristics including organics, nitrogen, phosphorus, detergents, and organic dyes are nonconservative, taken up by soil, or often difficult to differentiate from background levels after dilution in surface or ground water.

Approximately 30 mg/liter of chlorides are added to water during domestic use and chlorides are not diminished in passage through the soil. The chloride test was meaningful only when analyzing a suspected sewage discharge since varying concentrations in spring water and dilution tended to mask the sewage fraction.

Raw sewage contains about a billion coliform bacteria per 100 ml. These organisms are effectively removed in soil but when the soil assimilation process is bypassed because of poorly designed or illicit septic tank systems, these organisms can be detected in stream and spring waters, even after manifold dilution.

Sewage contamination of spring water was presumed when microbial counts were an order of magnitude greater than stream water counts. Contamination of a section of Oak Creek was presumed when levels were consistently more than twice average stream background levels.

The test results showed bacterial concentrations fairly uniform along the creek and generally below levels prescribed for bathing waters. However, the analyses did detect contamination of springs that flow near the surface through a particular trailer park development.

CONCLUSIONS AND RECOMMENDATIONS

Wherever possible, sewage disposal systems that utilize the assimilative capacity of the environment should be adopted for campgrounds or encouraged at second home developments. Current trends in wastewater management and regulation stress secondary treatment, but it is wastewater collection and conveyance that presents the most serious threat to a forest environment, rather than the age-old individual disposal methods (soil disposal, privies). If a septic tank or privy fails, the problem is significant but usually localized. If a sewage treatment plant serving a second home development fails or does an incomplete job of contaminant reduction, the detrimental effect on the forest environment is of much greater magnitude.

The key to waste disposal for second homes is not the adoption of septic tanks per se but rather utilization of the soil waste assimilative capacity. In areas such as Oak Creek Canyon that assimilative capacity is extensive and can support relatively concentrated

development and campsite use. At Pinewood, individual soil disposal systems are not feasible at home sites. Lot sizes are too small and the soil mantle is too shallow. However, a community septic tank system could have been built in the golf course in lieu of the existing sewage treatment plant. A septic tank and leaching field disposal system in the golf course area would have provided essentially the same degree of treatment and would have disposed of wastewater at the same location, for considerably less capital investment and operating cost. The treatment plant does serve to provide a high nutrient, recycled water for the golf course.

Waste disposal systems for three alternative forms of future development in Oak Creek Canyon were investigated: (1) restricting the entire canyon to daytime public use, (2) extensive overnight camping facilities throughout the canyon and (3) an expansion of the present mixed type of development, i.e., second homes, campsites and picnic areas. Conclusions pertaining to available sewage disposal methods for each pattern of development are illustrated in Table 3.

Biological and chemical analyses of surface and ground waters are expensive and require a great deal of replication before results are conclusive. To prevent surface and ground water contamination, sanitary surveys should be relied upon as well as strict adherence to and enforcement of health, pollution abatement and waste system design and installation standards.

Preventing pollution of National Forests entails establishing and enforcing recreational land use regulations on forest land, liason with state and local health authorities, and consideration of the impact of development in land purchase and exchange.

Table 3.--Wastewater disposal methods.

Disposal Method	Restricting Canyon to Daytime Use	Extensive Campsite Development	Second Homes Campsites & Picnic Areas
Vaulted Privies	preferred method economical least pollution potential requires well maintained sanitary land fill for disposal	acceptable method water using facilities preferred	acceptable at campsites and picnic areas
Septic-Tank Systems	applicable if water provided on site at large campgrounds	recommended only at large campsites	preferred method for second homes
Low Volume Flush Toilets and Chemical Recirculating Toilets	acceptable	acceptable	acceptable
Individual Sewage Treatment Units	Additional research and development is needed in this area. Effluent from units may still constitute sources of surface or groundwater contamination.		
Sewers and Secondary Treatment		not recommended	

Air Pollution Potential of Selected Areas in the Rocky Mountain West[1]

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With recreational, energy and mineral resources development of the western region of the United States a reality, the integration of environmental concerns into the planning process is essential if unnecessary environmental degradation is to be avoided.

Since standard air pollution potential indices now practiced have limited or no applicability for complex terrain analysis, a unique and imaginative approach to this complex problem is required.

By incorporating both the concepts of gaussian pollution dispersion and divergent windflow, an index designed to delineate relative air pollution potential areas was created. Qualitative rather than quantitative in character, the Divergent Pollution Dispersion Index can be utilized as an initial assessment tool of the air pollution potential of an area lacking appropriate meteorological data for the more standard air pollution potential indices.

INTRODUCTION

Since about 1968 the public has been increasingly concerned with augmenting cases of unbreathable air, undrinkable water, intolerable noise levels, and in general, a rapidly diminishing quality of the environment. A degrading environment, as well as shortages in food, energy and mineral resources, are the results of exponential population growth and a rising level in the standard of living. The discovery that the supply of available amenities such as land for recreational purposes is rapidly becoming limited in relation to actual and potential use demands, and the destruction of the very qualities for which these resources are valued, has forced a re-evaluation of our planning process to integrate environmental factors.

The importance of this integration procedure was recognized at the Federal level by Congress in the establishment of the National Environmental Policy Act of 1969. The states are also following suit with similar requirements and in many cases being more innovative. For example, the state of Colorado has instituted Senate Bill 35 and House Bills 1041 and 1035 providing local authorities the power to regulate certain types of growth under their jurisdiction.

A few of the many questions being voiced by the concerned citizen and governmental planning agencies are: How severe is the air pollution now? What is causing it? Who is causing it? Is it getting worse? Where are the areas with the greatest air pollution potentials? An answer to the last question is vital to the planner. It is crucially needed to provide information for short and long term

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land use, transportation and zoning decisions. When the maintenance of high air quality is the concern, identification of areas with high and low air pollution potential is far more beneficial in the hands of a planner than is knowledge of existing emissions in the hands of the engineer for the expost facto control of such sources.

In general, at least when compared with many other areas of the country, the quality of the air in the Rocky Mountain region is excellent. However, the atmospheric environment within the region is quite fragile. As growth develops, this characteristic will vanish. Evidence can now be observed; one has only to make a casual glance over a developed area in a small mountain valley on a cool, still morning to see that the carrying capacity of the lowest layer of the atmosphere is nearing its limit.

Except for a rather sparce network of state operated particulate samplers and several short-term intensive monitory programs for specific developments, there are no systematic scientific measurements of air quality across the region. Furthermore, the meteorological data needed to determine the air pollution dispersal capabilities is not available for a majority of the areas. This is coupled with the fact that the standard air pollution potential indices now in use have limited applicability for complex terrain and mountain airsheds analyses. As a result, even from a subjective or qualitative point of view this is a complex problem requiring a new and imaginative approach. This paper describes a new approach to the determination of air pollution potential over complex terrain. The Divergent Pollution Dispersion Index (DPDI), refined in response to the Eisenhower Consortium, is this unique tool that can be utilized as a first approximation in the delineation of an area's air pollution potential and dispersion capabilities.

THE ATMOSPHERIC TRANSPORT ANALYSIS PROBLEM

The air quality of a given area is directly dependent upon the meteorological environment, i.e. the ability of the atmosphere to disperse source emissions. Panofsky and Prasad (1967) and others (Reeser and Marlatt, 1973; Fox, 1975) have shown that the major parameters of the atmosphere controlling the transport of airborne materials are the vector wind field, the vertical temperature structure and the occurrence and nature of precipitation.

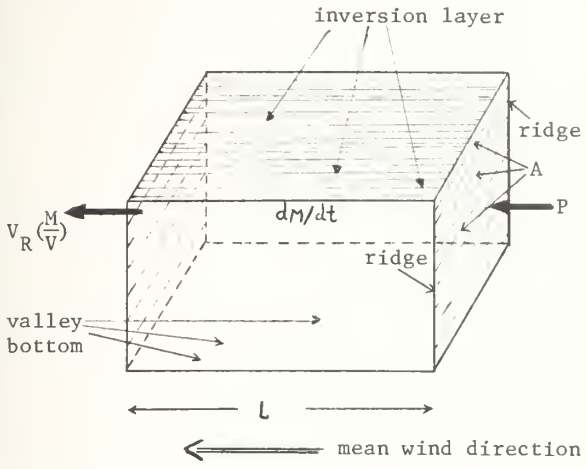
The physical transport of airborne materials is primarily controlled by the existing atmospheric motion. Unfortunately, this is complicated by the fact that the velocity field, separated into three components (u,v,w) in each of the Cartesian coordinate directions (xyz), is neither constant in time nor in space. As a result, the transported materials are subjected to variable diffusion due to turbulence along the mean resultant streamline. Furthermore, the amount of turbulence is influenced by topography and thereby the vertical air temperature structure.

Theoretically, with sufficient air flow measurements and temperature soundings in very fine detail in time and space, it should be possible to determine the air pollution dispersion capabilities of the atmosphere using one of a number of sophisticated numerical diffusion models (Eschenroeder, et al., 1972; Shir and Shieh, 1974). Obviously one of the major obstacles to the undertaking of such analyses for the Rocky Mountains is the lack of surface and atmospheric wind and temperature data throughout the region. Obtaining such data is extremely expensive and tedious and what data are available are from the larger urban areas which are usually located in isolated valleys or basins distant from the area of interest, spatially as well as in character.

Equally as critical a factor is the effect of terrain on producing a more non-uniform windfield which results in a non-gaussian diffusion pattern. As a result, the statistical dispersion of pollutants cannot be predicted where the wind follows the randomly oriented topographic features. It has been observed, therefore, that in mountainous regions the air pollution potential is most strongly influenced by the divergence/convergence of the windfield.

For detailed studies of individual mountain valleys, a method receiving considerable attention is the "ventilated valley" or "box" model (Marlatt, Holben and Renne, 1973; Marlatt and Gelinas, 1975) (fig. 1). This approach subdivides the terrain into sets of valleys and ridges (boxes of known volume) and calculates the atmospheric carrying capacity of the valley under various ventilation rates and mixing depths, or inversion layer heights (fig. 2). The ventilated valley model, while of considerable usefulness in land use planning on a local scale, is usually limited by lack of information on the height of the temperature inversion and the detailed windfield statistics. Another complicating parameter is that, while most of the large scale air motion is horizontal or two dimensional, the velocity field is often different from one layer to the next producing wind shears in both direction and magnitude. For example, after sunset the layers of air nearest the ground often become disassociated from the larger scale flow aloft and are controlled by density/gravity (i.e. drainage flow into valleys) factors. The topographic variations for

mountainous regions occur on all scales, however the small scale changes in terrain are of particular importance for evaluation of air pollution potential under light drainage wind conditions.



where M is the amount of pollutants
V is the volume of the valley "box" (Area (A) x Length (L))
V_R is the ventilation rate
P is the emissions rates of pollutants

Figure 1.--Diagrammatic representation of the "ventilated valley" diffusion model.

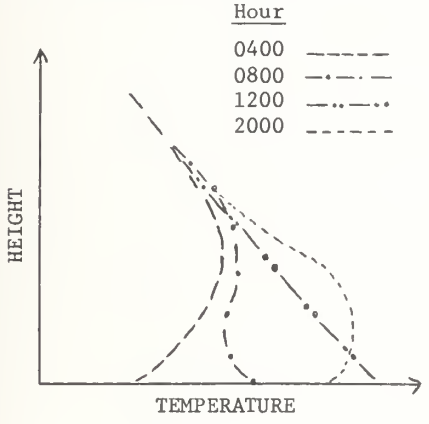


Figure 2.--Example of an observed daily temperature structure above a mountain valley floor. Note: an inversion layer is defined as a layer of the atmosphere whose temperature increases with height.

THE ATMOSPHERIC DIVERGENT POLLUTION DISPERSION INDEX (DPDI)

Because of the limitations of the use of sophisticated trajectory and the ventilated valley diffusion model analyses, a totally new approach was undertaken to develop an indexing system applicable over complex terrain airsheds. By incorporating features of both gaussian dispersion and divergence, the Divergent Pollution Dispersion Index was first developed as part of a power plant siting study in Colorado and has subsequently been used for land use planning, water resources development and mineral development studies (Reeser and Marlatt, op. cit., 1973; Marlatt, 1974; Marlatt, Howard, Steinhardt and Harbert, 1974; and Marlatt and Harbert, 1975).

The index accounts for the divergence and convergence of parcels of polluted air which have trajectories controlled by topographic and microclimatic phenomena. The DPDI calculations are limited to periods when the topographic and microclimatic controls of slope, aspect, surface roughness and elevation variations dominate the meteorological environment of mountain airsheds.

Prior to utilizing the index, the small scale wind and divergence fields must be known. Acquisition of this information is achieved by employing a simple one layer model of atmospheric boundary layer flow over complex terrain. This model, the WINDS model (Fosberg, Rango and Marlatt, 1972; Fosberg, Marlatt and Krupnak, 1975) is based on a mean value interpolation of the dynamical equations governing atmospheric boundary layer flow, and that the kinematic interactions are neglected so that the model represents the thermal driving forces and frictional dissipation forces. While the model is still being refined and modified, initial validation indicates that calculated grid point wind directions are within $\pm$ 1 compass point on a 16 compass point scale and wind speeds are estimated to within 10-25%.

The only inputs needed to determine the velocity vector and divergence field using the model are the air temperature of the surface layer, the temperature-altitude relationship, synoptic scale windfield and the terrain features of the underlying ground surface.

For land use planning purposes, it is not necessary to measure the surface air temperature at each computational grid point, but to assign temperature values at the valley bottom and a stability class representative of that associated with an air stagnation condition.
A single test case also indicates that surface temperatures as mapped by weather satellites are useful for obtaining surface temperature estimates. Surface elevations and roughness

lengths (vegetation types) can be obtained from U.S.G.S. topographic analyses. The temperature-altitude relationship can be defined by a normal lapse rate and the synoptic scale wind (the background potential flow) can be assigned the value of 1-3 mph for conditions associated with air pollution problems.

An example of the output and analysis for wind direction and wind speed and divergence/convergence is provided (figures 3, 4, 5, 6).

	2	3	4	5	6	7	8	9
9	S	S	S	S	SW	SW	NE	E
8	SE	S	SW	SW	SW	SW	S	E
7	SE	S	SW	SW	SW	SW	S	SE
6	SE	S	SW	SW	SW	SW	S	S
5	E	SE	SW	SW	SW	SW	S	S
4	E	SE	SW	SW	SW	SW	S	S
3	E	SE	SW	SW	SW	SW	S	S
2	E	N	NW	SW	SW	SW	S	S

Figure 3.--Wind directions for North Park, Colorado calculated for an incident south wind at 1.5 m/sec.

	2	3	4	5	6	7	8	9
9	3.3	3.4	2.7	2.3	2.2	1.2	1.0	1.2
8	2.6	3.4	3.1	2.4	2.6	2.9	1.5	2.0
7	2.8	2.6	3.1	2.8	2.7	2.9	3.1	2.4
6	3.0	1.6	2.5	2.6	2.6	2.6	2.6	3.0
5	2.7	.8	1.9	2.2	2.3	2.3	2.1	2.3
4	2.4	.7	1.5	1.9	2.0	2.0	1.8	1.8
3	2.2	.7	1.2	1.7	1.9	2.0	1.5	1.2
2	1.3	.6	.4	.6	1.0	1.6	1.7	1.3

Figure 4.--Wind speeds for North Park, Colorado in m/sec. calculated for an incident south wind at 1.5 m/sec.

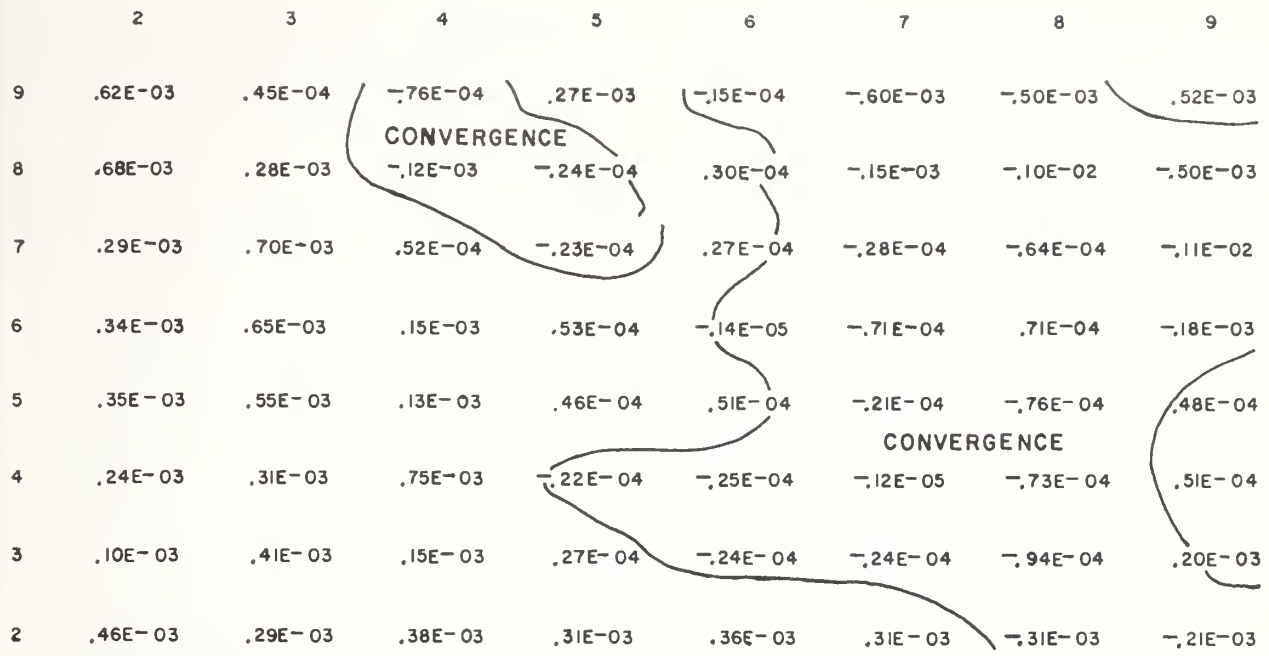


Figure 5.--Divergence and convergence analysis for North Park, Colorado (units of sec^{-1}).

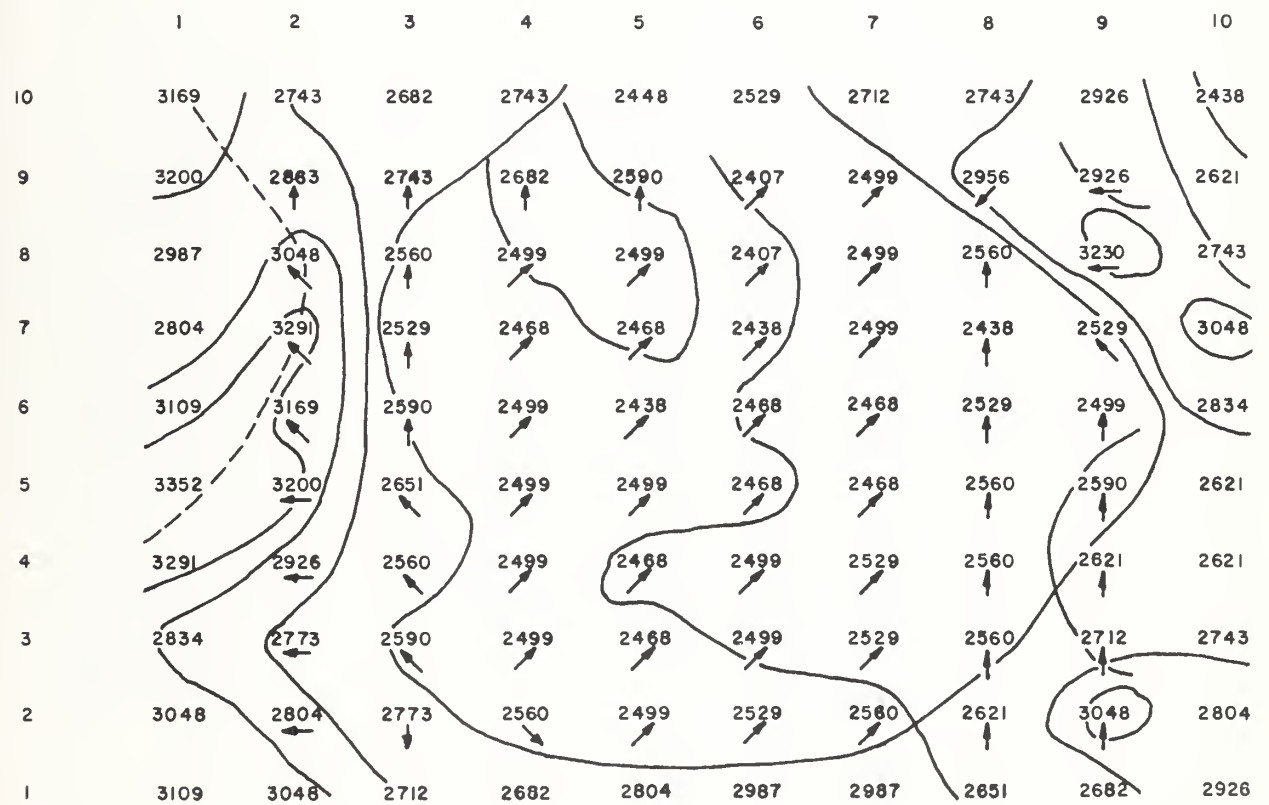


Figure 6.--Elevations (in meters) and wind directions for North Park, Colorado.

Having the wind velocities and divergence values at each grid point covering the area of study, use of the Divergent Pollution Dispersion Index can be commenced. The index has the form:

$$I = \frac{\chi_{max}}{Q} - \left(\frac{D\chi_{max}}{Q}\right) t$$

where χ_{max} is the maximum downwind pollution concentration; Q is the source strength, D is the divergence and t is a time constant. The divergence is defined as:

$$D = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} \quad .$$

As polluted air moves away from a given location (divergence) the index is equal to a value less than that calculated for non-diverging windfields. For a situation where polluted air is converging on a given area (negative divergence) a value greater than for the gaussian case is observed. For the situation of zero or very little divergence/convergence, the index reduces to the gaussian dispersion assumption.

LAND PLANNING USES OF THE D.P.D.I.

The models have been valuable in identifying areas where the meteorological and topographical conditions interact to produce air stagnation and, if emissions are present or planned, areas of high and low air pollution potential can be located.

To date, the index has been employed to delineate areas likely to possess a high pollution potential for power plant siting (Reeser and Marlatt, op. cit., 1974), for ski area development studies (Marlatt, Howard, Steinhardt, and Harbert, op. cit., 1975), for

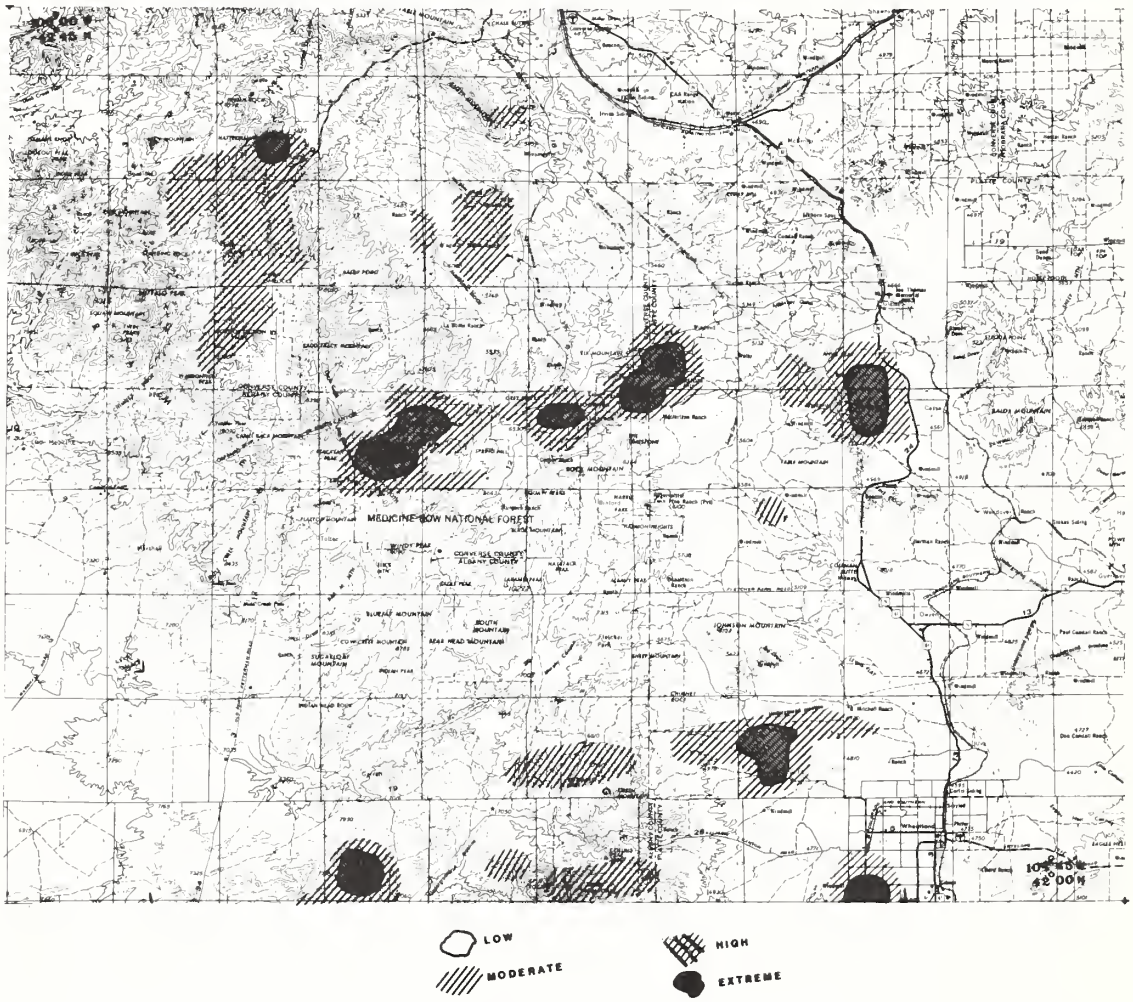


Figure 7.--The air pollution potential in the vicinity of Laramie Peak, Medicine Bow National Forest, Wyoming.

county land use planning (Holben and Marlatt, 1974) and for mine development planning (Fosdick, Marlatt and Howard, 1974), etc.

The value of the maps of air pollution potential is highest early in the planning process. During this stage, the overall dispersion capabilities of the atmosphere can be assessed. For example, the location for a mine tailing pile may be selected which would neither be situated in a region of strong wind channelization nor in a region of high stagnation potential.

Pollution potential maps have been prepared for the entire state of Colorado, the National Forest lands of Wyoming and the Black Hills region of South Dakota. Examples of several areas are provided in figures 7 and 8.

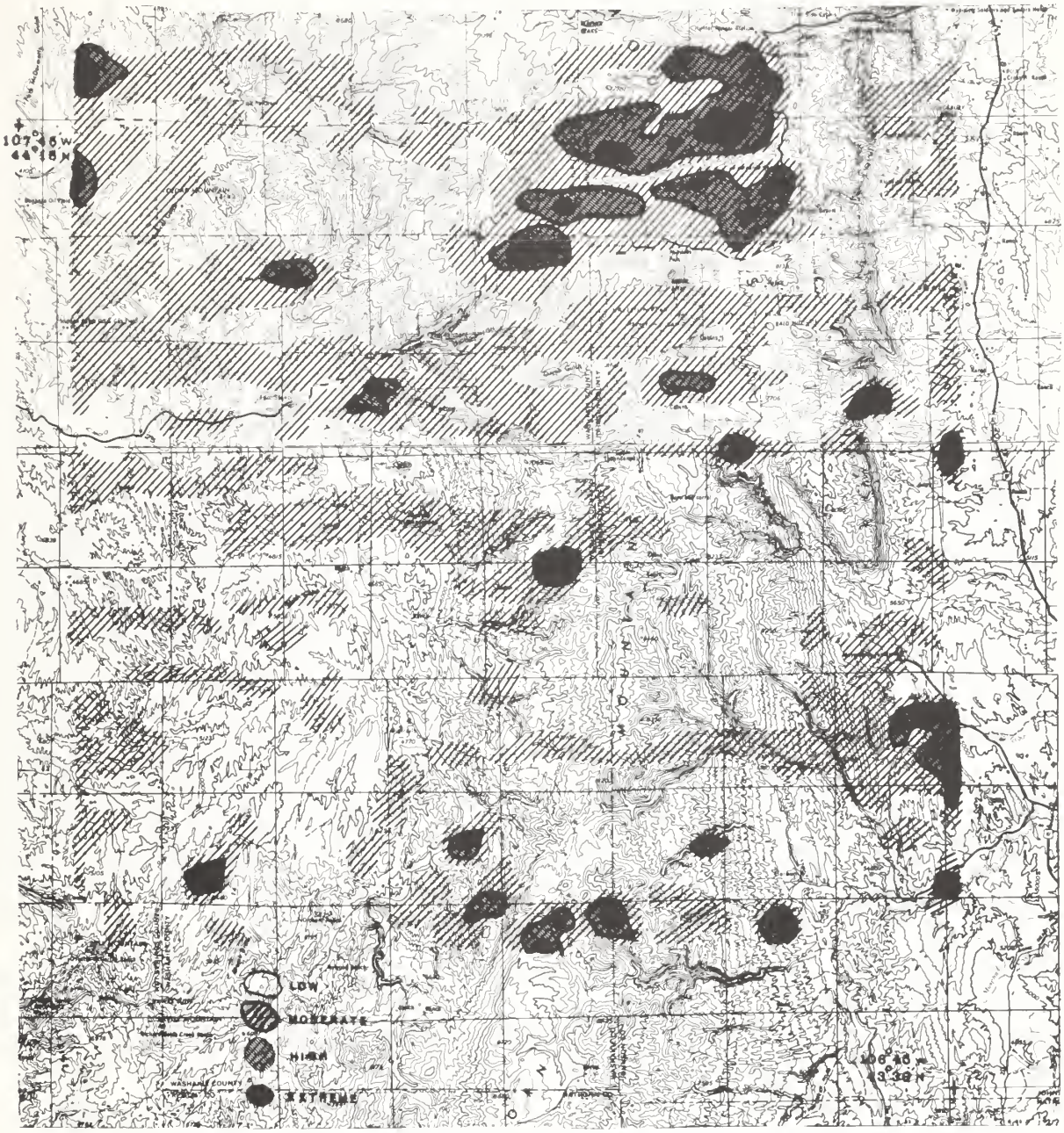


Figure 8.--The air pollution potential in the vicinity of Powder River Pass, Bighorns National Forest, Wyoming.

Grid scale spacing from four miles to one-eighth of a mile has been practiced and in all cases, the computed results indicated excellent correlation with expected results and physical believability. While the grid scale of four miles is probably not sufficient in some areas for specific activity planning, this scale can provide information on the relative magnitude of air pollution potential across the region. As the planning progresses, the DPDI can be re-evaluated using a closer grid spacing to refine the evaluation.

While it is recognized that the maps of air pollution potential are only qualitative, further development is planned which will provide quantitative definition of the pollution potential. It is to be understood that in most cases further air quality information and analyses must be performed before a final decision on planned development be made.

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Air Pollution Potential in Arizona[1]

Neil S. Berman[2]/

Abstract.--Background and urban levels of present air quality are presented for reference. Wind speeds and mixing heights, the important parameters in air pollution potential are discussed for the state. These are used in models to evaluate air pollution potential for several locations.

INTRODUCTION

Air pollution potential has been defined as "the inability of the atmosphere to disperse and dilute contaminants which may be emitted into it." On a local scale unacceptable levels of pollution may mean one level in a certain location and a quite different level in another. Air quality in Arizona is often very visible. The plume from a stack is visible in the early morning when the atmosphere is stable. The urban haze in the afternoon can be seen 50 miles north of Phoenix. However, at ground level the concentrations of pollutants are very low in these two cases. We can see small quantities of pollutants in the atmosphere because the present air quality is good. Atmosphere conditions and topography in Arizona generally lead to visibilities in excess of 50 miles.

Although air pollution potential does not depend on current levels of pollutants, this discussion will start with present urban and background levels. Then the geographical and meteorological factors important in the evaluation of air pollution potential will be presented. The final part of the presentation describes the use of models in the prediction of pollution potential.

Arizona is divided geographically into three regions: the northeast, a part of the Colorado Plateau; the Mexican Highland region cutting a diagonal path from the northwest to southeast; and the southwest Sonora desert.

[1]/Paper presented at the symposium on Man, Leisure, and Wildlands: A Complex Interaction, Vail, Colorado, Sept. 14-19, 1975.

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Most of the recent growth of Arizona has occurred in the southwestern area where the large urban areas are located. In the mountain region, the interaction of man and wildlands is most intense. The permanent population density of 5 persons per square mile swells manyfold during the seasons of recreational activity. It will be important to remember these locations in the discussion that follows.

Present Air Quality

Measurements of total suspended particulates and sulfur dioxide have been taken at many locations in the state of Arizona over a period of years. Other pollutants such as carbon monoxide, hydrocarbons, nitrogen oxides and oxidants are only measured at urban sites in Phoenix and Tucson. Standard techniques for nitrogen oxides and oxidants have only been available for a short time so the interpretation of past data for these contaminants is questionable.

The generally accepted method for the measurement of suspended particulate matter is the net weight of material collected on a 20- by 25-centimeter glass fiber filter through which approximately 2200 cubic meters of air have been drawn over a 24-hour period. At least one such determination each six days for a year is necessary to obtain the yearly average. Figure 1 shows the yearly average in Arizona for 1973 in the commonly accepted units of micrograms of particulates per cubic meter of air. These data and the data for other pollutants were obtained from the Arizona State Department of Health Services (1974) and the U.S. Environmental Protection Agency (1974). For particulates the U.S. national background sites average is 30 micrograms per cubic meter and the total U.S. average is 68. The Arizona State standard is 60 (all based on the yearly average).

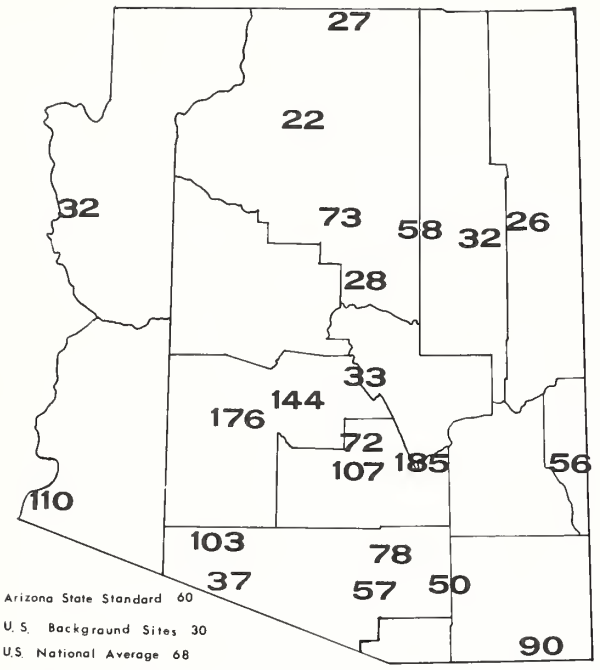

Figure 1.--Total suspended particulates in Arizona on a map showing county boundaries and typical annual average concentrations at the approximate measurement location. Units are micrograms of solids per cubic meter of air.

The Arizona background varies from approximately 30 micrograms per cubic meter in the plateau and mountains of the northern part of the state to approximately 50 micrograms per cubic meter in the southern deserts. Grand Canyon National Park registers 22, Montezuma's Castle National Monument 28, Petrified Forest National Monument 26, and Organ Pipe National Monument 37. Particulates above these background levels are locally generated and annual averages are functions of the urban size and activity and the local wind speeds. More will be said about wind speed later. Here it is noted that the desert areas have much lower wind speeds than the mountain and high plateau regions.

Significant trends toward decreased levels of suspended particulates as shown in figure 2 have been evident in the major urban areas of the state in spite of the rapid growth of population. Among the reasons for the decline are paving of roads and decreases in agricultural and building activity near the monitoring sites. Phoenix remains quite high, although not unreasonable for an urban area of 1.2 million people. Even small urban areas lead to increases in the particulate count above the background as shown in figure 3. The valley type of desert areas show consistently higher values than the mountain group. Some very high values for small towns are due to the large amount of industrial or mining activity in the area.

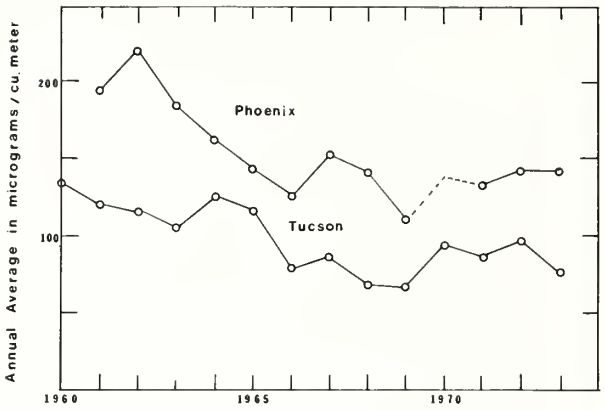

Figure 2.--Trend of total suspended particulates at stations in Phoenix and Tucson which have a record of data for a number of years. Concentration units are micrograms per cubic meter.

Very extensive monitoring of sulfur dioxide in the air is carried out in Arizona. Figure 4 shows the average concentrations at typical sites. Except for copper mining areas and nearby locations the measurements are below the U.S. background site average of 10 micrograms per cubic meter. The locations marked with the triangles each have several monitors and concentrations are high in certain directions only. The U.S. national average is 25 and the state standard 50. Note that Phoenix with 9 and Tucson with 7 are not much different from the Grand Canyon with 6 and that mining activities in the state show up only locally.

The other contaminants are significant in urban air pollution and have significant variations with the diurnal cycles of sunlight,

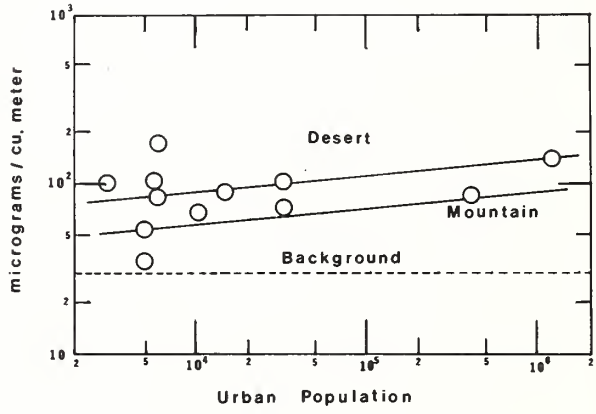

Figure 3.--Total suspended particulates as a function of urban population on log-log scales. Concentration units are micrograms per cubic meter.

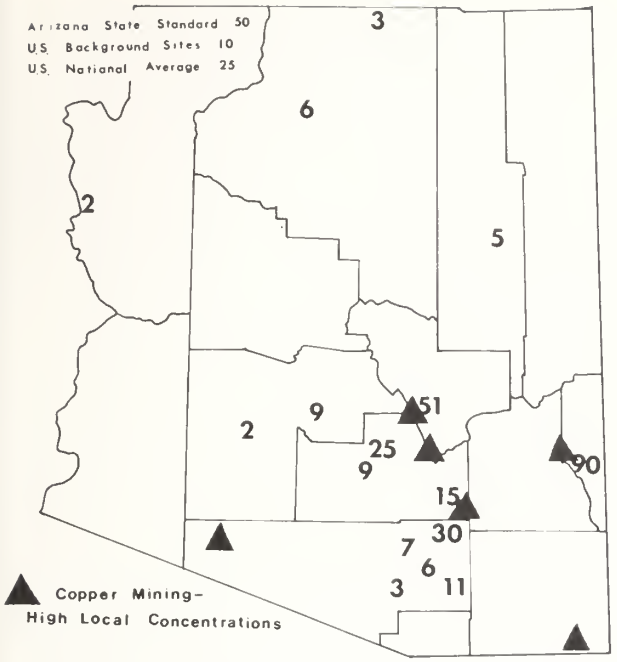

Figure 4.--Sulfur dioxide concentrations in Arizona. Typical annual average concentration in micrograms per cubic meter are shown at approximate measurement locations. Triangles are copper mining areas.

automobile traffic and winds. Annual averages are generally near background even in the urban areas except for NO_2. However, carbon monoxide concentrations in parts of Phoenix exceed the 8-hour standard of 10 parts per million (11,456 micrograms per cubic meter) in the late evening when wind speeds are low in the winter months. Over 95% of the carbon monoxide is generated by automobiles. Hydrocarbons and nitrogen oxides are also high during the times of high carbon monoxide concentrations but the amounts are far below the standards. Oxidant concentrations can be high from noon to 4 p.m. when wind speeds are low. The oxidants are produced by reactions involving nitrogen oxides, hydrocarbons, air, water vapor and sunlight. The necessary concentrations or amount of these constituents to produce oxidant concentrations approaching the standards are present on several days in spring and summer in Phoenix and Tucson. Aerosols produced by these same reactions even in small concentrations drop the visibility markedly, however, so little amounts are easily noticeable. These aerosols and nitrogen dioxide are responsible for the urban haze which spreads over considerable areas at times.

The mean visibility in the Petrified Forest National Park in 1973-1974 was found to be 70 miles (Roberts et al 1974) during the daylight hours. During the year the best visibility occurred in winter with an average 78 miles with fall and spring giving 70 miles and summer 60 miles. Nitrogen dioxide concentrations in the Petrified Forest average 13 micrograms per cubic meter on an annual basis, but the highest 24-hour average was 53 in 1973. Using the analysis presented by Robinson (1968) it can be shown that an observer looking at the horizon will definitely see a brownish coloration due to the nitrogen dioxide when the visibility is 70 miles and the nitrogen dioxide concentration is at the maximum. Such conditions of high visibility exist in all parts of Arizona including the urban areas. In Phoenix, the NO_2 discoloration is observable in the early morning in the western part of the Salt-Gila River valley when the visibility is high and small amounts of NO_2 remain in the air from the previous day's traffic. In most other urban areas of the U.S., normal visibilities are much lower and higher concentrations of NO_2 are needed to discolor the air.

Another consequence of the urban atmosphere is the absence of oxidants at night when the reverse of the day reactions occur. Although few measurements have been made in rural areas, we suspect that a small level of oxidants persist as a background at all times. The much different diurnal pattern of nitrogen oxides and oxidants in the urban atmosphere is just beginning to be studied.

Present air quality in Arizona is therefore generally quite good with respect to air quality standards. Only local problems exist and there is a definite improvement trend. Improvements in the aesthetic appearance of the air require different standards than the present ones related to health.

AIR POLLUTION POTENTIAL

Important Parameters

The concentration of pollutants in the local atmosphere is governed by the amount of emissions and the dilution of these emissions by mixing and removal in the atmosphere. If the emissions are at ground level in relatively flat terrain, the problem can be related to mixing in a box whose height is set by the mixing characteristics of the atmosphere and the horizontal dimensions determined by the wind speed. The smaller the box, the higher the concentration of pollutant will be.

Atmospheric conditions are not predictable in advance so we can only deal with probabilities based on past experience. Any given combination of atmospheric conditions will never occur again in precisely the same way. Thus air pollution potential deals with maximum

expected concentrations, averages or typical exposures and large deviations from these can be expected.

First we will define and discuss conditions of importance in the prediction of air pollution potential in Arizona: wind speed and wind direction; and atmospheric conditions responsible for mixing height.

Wind Speed and Direction

Records of wind speed and direction are not abundant for Arizona. Ideally, we would like to have data on wind speed, direction and atmospheric stability in the form of joint probability distributions. Such information is available from the National Climatic Center for six cities in Arizona. However, we cannot extrapolate very far from the location of the measurement and any use of the data requires familiarity with local topography.

Wind direction probabilities based on at least one year's data of hourly measurements are more readily available. In general, southwest winds are most frequent across the entire state. Figure 5 shows the average wind speed at several locations and the direction second most frequent. Wind speeds are higher in the northern part of the state compared to the south. The direction shown on the map often corresponds to the night drainage wind.

Frequencies of wind direction are reported for 16 compass directions or sectors. If we compare the wind direction frequency for the three sectors in the southwesterly direction for the northern and southern parts of the state, we find that between 30 and 40 percent of the time winds are from these directions in the north compared to approximately 20 percent in the south. Definite drainage winds account for 30-40 percent of the frequency distribution in the south but only 10-20 percent in the north. Terrain-influenced upslope winds appear in the frequency distributions in the south also. The terrain influence on local wind climatology of Arizona cities is much more important in the southern desert part of the state than in the mountain or plateau regions of the north. This is generally attributed to the higher elevation of the north and the increased contact with the prevailing winds characteristic of this higher elevation. Some modifications would have to be made to these observations for some rugged areas of the state like the rim area.

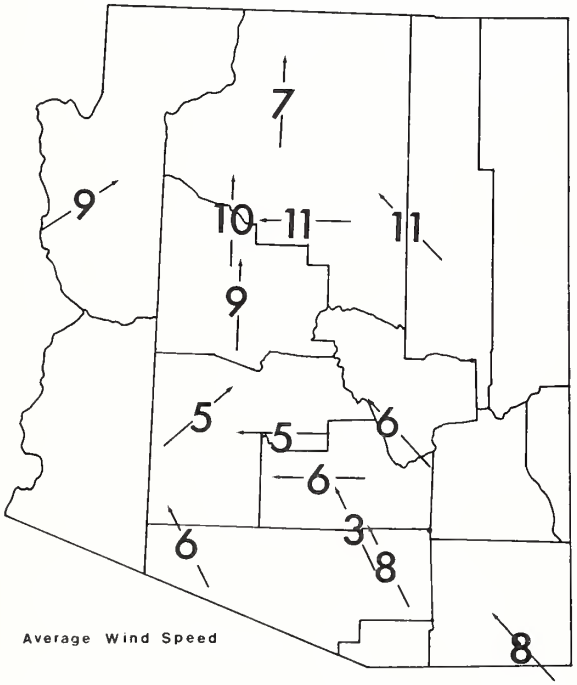

Figure 5.--Annual average wind speeds in Arizona.

In the river valley areas of the state, a definite drainage wind develops at night. Cold air from the higher elevations flows down the slopes and down the river also. In Phoenix, these drainage winds as shown on figure 6 develop between 6 and 8 p.m. in the winter and last until noon the next day. In the summer, only poorly developed drainage winds form between 2 and 4 a.m. and last about 8 hours. Daytime heating of the valley upper floor and the slopes leads to upslope and upriver winds in the afternoon. Again in Phoenix, as shown on figure 7, these upslope winds start at noon and last until six in winter and until midnight in summer. The winter afternoon winds are light, poorly developed and highly affected by low mountains while the summer afternoon winds

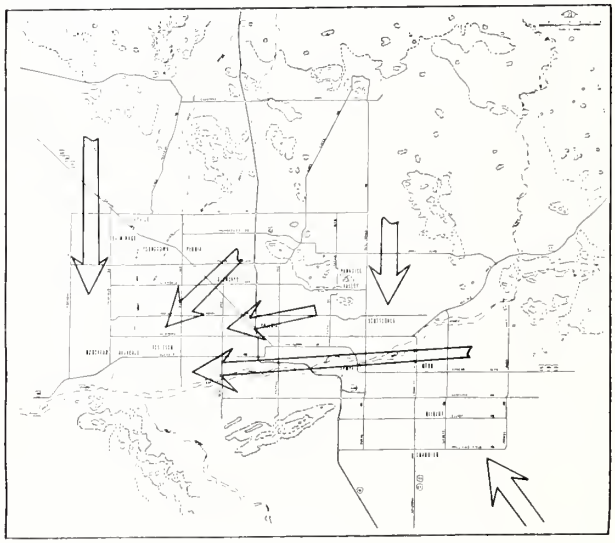

Figure 6.--Drainage winds in the Salt River Valley near Phoenix.

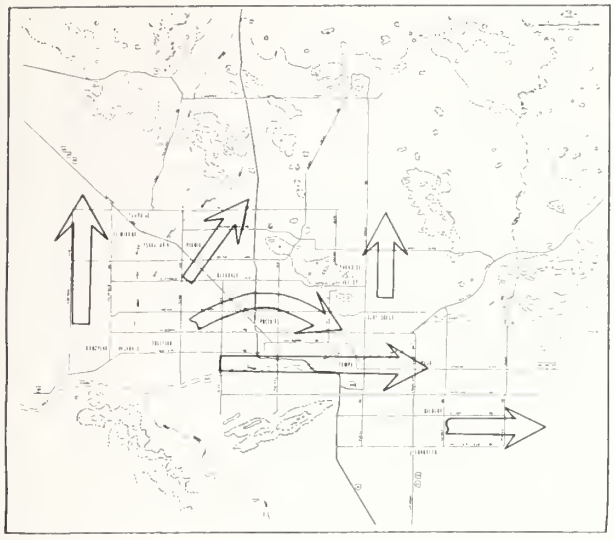

Figure 7.--Upslope winds in the Salt River Valley near Phoenix in winter. The curved arrow in the center becomes straight and directed to the north in summer.

are much stronger and blow over the low hills and mountains. Tucson winds are similarly influenced by the terrain and have a somewhat higher speed at the airport compared to Phoenix. Different spots in Phoenix and Tucson show widely varying wind patterns with average velocities ranging from 3 to 8 miles per hour at locations less than 10 miles apart. Obviously accurate predictions of air quality are possible only after detailed studies of a particular location. Wind frequencies and speeds at a single point can only provide a qualitative basis for comparison for long-term averages.

Mixing Height

Holzworth (1972) has compiled data on mixing heights and wind speeds for the United States. The wind speed graphs for Arizona are misleading and the discussion in the previous section should be used. Mixing height presentations, however, are reasonable. Only two upper air stations are presently operating in Arizona and these were used by Holzworth. In Arizona, unless a front producing rain or winds with accompanying mixing is present, there is a strong ground-based inversion from sunset to sunrise. After sunrise the solar heating leads to breakup of the inversion and finally to a very unstable atmosphere in the afternoon. For only about 10% of the time are fronts present. Therefore monthly average upper level data can be used to evaluate the mixing characteristics.

A set of typical observations of temperature vs. height for Tucson is shown on figure 8. Although this is for a single day, the

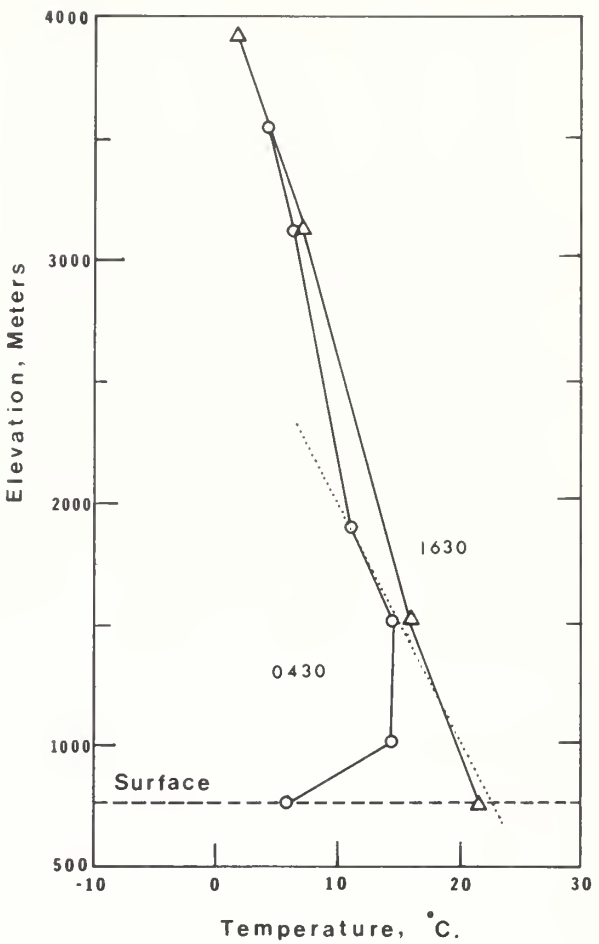

Figure 8.--Tucson Radiosonde November 26, 1974 at 0430 and 1630 time.

averages are similar. An inversion is indicated when the temperature increases with height as on the early morning observation. On this particular day the height is 720 meters (which is very high for Tucson) before the temperature begins to decrease with altitude. At upper levels, the temperature profile does not change much between early morning and afternoon. The "urban morning mixing height" is found by increasing the minimum surface temperature by one degree or so and drawing a line with a slope equal to the dry adiabatic lapse rate until the line intersects the measured curve shown. The height above the surface is called the mixing height. The afternoon mixing height is found in a similar manner using the maximum temperature at the surface and intersecting a dry adiabatic line with the afternoon radiosonde. Sometimes the morning radiosonde is used for both mixing heights. These mixing heights are not true representations of the heights to which pollutants will mix, but the afternoon one is qualitatively representative. The morning mixing height is best calculated from tem-

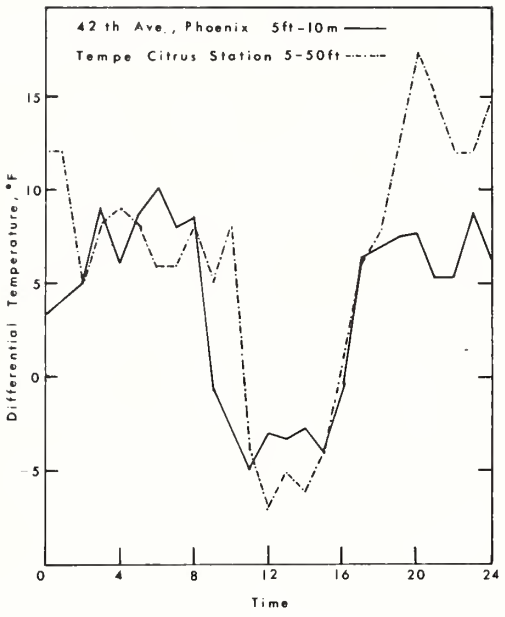

Figure 9.--Diurnal vertical temperature differences at two locations near Phoenix, Arizona, November 26, 1974.

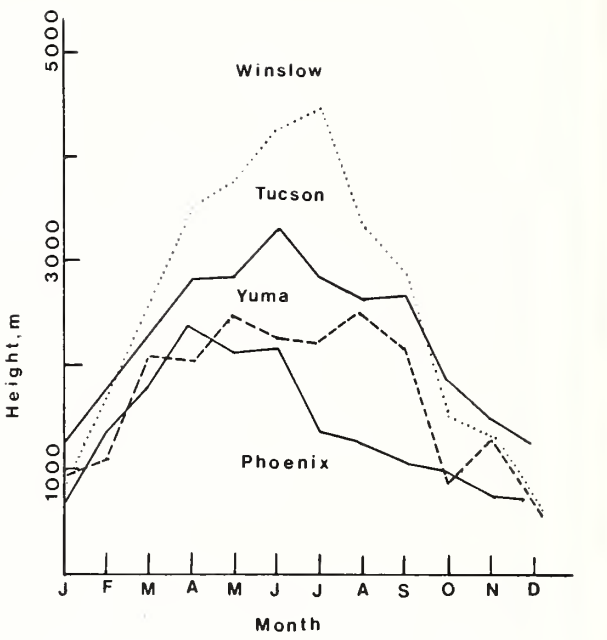

Figure 10.--Afternoon mixing heights in meters above the surface at four locations in Arizona. Yuma and Phoenix based on two years data; Winslow and Tucson, five years.

perature measurements near the ground for extremely stable conditions and the urban heat island in Arizona can be ignored. Figure 9 shows the temperature difference between two heights at two locations in Phoenix. The extent and duration of strong stability, strong instability and abrupt changes between are shown. The diurnal cycle of vertical stability does not correspond to the wind shift cycle.

It is sufficient to use the temperature data of figure 9 to obtain the morning mixing characteristics along with a dispersion model. In the afternoon, upper level mixing heights calculated as described would be more valuable than figure 9. Also, the inversion depth in the morning can be used in stack design evaluation. This inversion depth is the same all year at four locations in Arizona and the average values are shown below.

Location	Inversion Depth (meters)
Phoenix	210
Tucson	223
Winslow	514
Yuma	407

There is a tendency toward shallower inversions during the spring and summer in the desert areas. The monthly variation of afternoon mixing height is shown on figure 10. Dry air and high solar heat flux in the spring months give the highest mixing heights.

There is a possibility that the afternoon mixing will be limited by an upper level inversion. Holzworth has tabulated the number of days of limited mixing at Tucson over a period of five years and at Winslow for three years. It is apparent from figure 10 that to avoid common winter values afternoon mixing heights of less than 500 meters only would be significant. During this period Tucson had only one period of two days duration when the afternoon mixing height was less than 500 meters. The wind speed was between 4 and 6 meters per second during the two-day period. Winslow in the three-year span had 13 periods with mixing heights less than 500 meters and wind speeds less than 6 meters per second. Two periods were for greater than 5 days and a total of 49 days were involved. Las Vegas, Nevada had 7 episodes for a total of 16 days with mixing heights less than 500 meters and wind speeds less than 6 meters per second. At both Las Vegas and Winslow, most of the wind speeds were between 2 and 4 meters per second. The potential for prolonged episodes is thus greater in the northern and western parts of the state and is small in the south central area.

Prediction of Air Pollution Potential

One criterion in air pollution potential has just been discussed--the potential for prolonged episodes of low afternoon mixing heights and low wind speeds. Several episodes can be expected each winter in the northeast part of the state and perhaps one each winter in the southwest. The probability of an episode in the central and southeast parts of the state appears to be one in five or more years. In addition, large point sources such as power plant stacks could be located above the top of the nighttime ground-based inversion layer in the central and south central deserts since the inversion layer is less than 300 meters high. However, the deeper inversion layers in the west and north would prohibit this strategy. When emissions are released above the inversion layer, they will not mix to the ground until after the inversion breaks up. Release within the stable inversion layer also tends to limit mixing to the ground, but high concentrations can exist at the time of inversion breakup.

Inversion breakup is a condition which calls for estimation of pollution concentration on a short time average basis. Exact estimates of the average exposure at ground level at different distances from the point source are not possible at the present time. An idealized procedure called a Gaussian Plume Model can be used in this case and also for yearly averages based on the wind frequency data for planning purposes. The justification for the model, illustrations of its use and tables of parameters corresponding to different atmospheric conditions can be found in Pasquill (1974), Slade (1968), Smith (1974) and Turner (1970) and other similar references. We will use the Gaussian model to compare air pollution potential at different locations in Arizona for a point source and an area source. Short-term concentrations when influences of changing wind patterns, terrain, chemical reactions in the atmosphere and variations in emissions are important cannot be modeled as easily. We will discuss this problem and present some results for diurnal carbon monoxide concentrations in Phoenix, Arizona.

Gaussian Plume Models

Hanna's (1973) computer program was used to calculate concentrations from a point source located at the center of a nine-by-nine grid with each grid square five kilometers on a side. The concentration, C, is related to other variables by the equation

$$C = AfRQ/U$$

where A is a constant, f is the wind direction frequency, R is a function of source height, distance from source and characteristics of the atmospheric mixing, Q is the emissions rate, and U is the velocity. If we hold the function R and also Q constant, the ratio of f/U determines the concentration. Maximum concentrations of neutral stability corresponding to a yearly average estimate are shown on figure 11. This representation of air pollution potential shows higher possible pollution exposures in the low wind speed areas of the state. The relative values shown on figure 11 would apply for a single point source at any height. For a specific source at a specific height and a specific location, a graph can be prepared as shown in figure 12 for Winslow. We have constructed such graphs for many locations in the state so that they can be overlayed on U.S. Geological Survey maps. The southwestern prevailing wind leads to the location of maximum concentration to the northeast of the source. At Winslow the drainage winds blow from the southeast giving a second high concentration region northwest of the source. Since similar wind frequencies occur over most of the mountain and plateau of northern and eastern Arizona, such an overlay can be useful for air quality potential evaluation over a wide area.

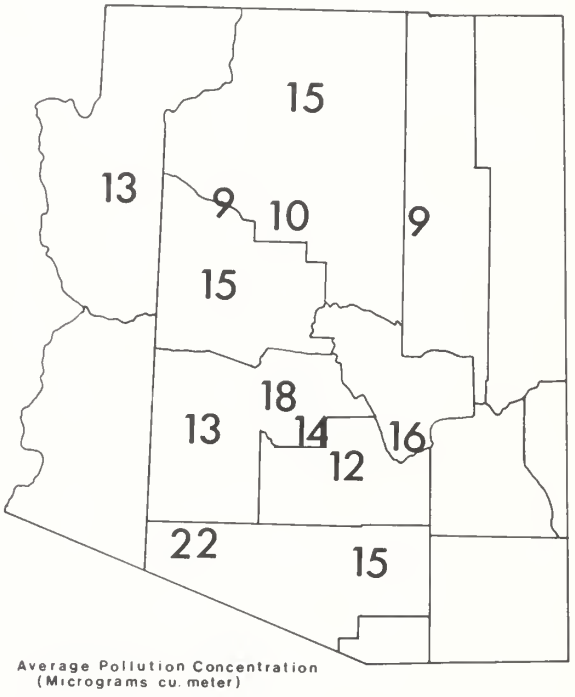

Figure 11.--Maximum annual average pollution concentration due to a 100-meter stack emitting 100 grams per second; units are micrograms per cubic meter.

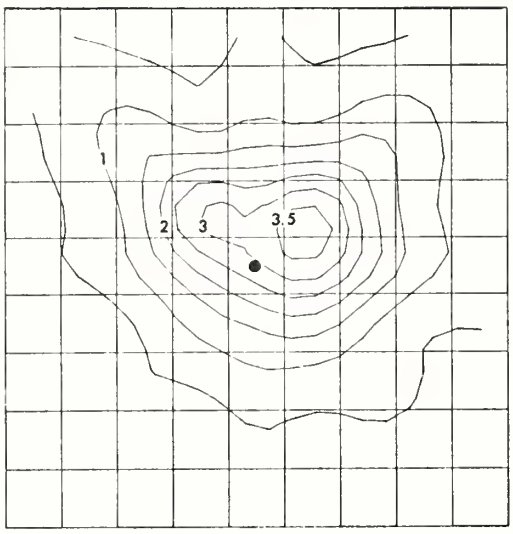

Figure 12.--Isopleths of concentration for a point source at Winslow, Arizona. Conditions are the same as for figure 11. The source is at the center dot; north is at the top.

The same computer program will also evaluate the average concentration for an area source. Automobiles, small industries and home burning and heating all combine to give a widely spread ground level emission. For comparison purposes, we used emissions in a one-kilometer square to obtain the ratio of concentration per unit area to emissions rate, χ/Q, for the same locations as the point sources. The results are shown on figure 13 for the emissions square. On this yearly average basis neighboring squares had negligible concentrations. The numbers on figure 13 correspond to 30 to 50 second homes in the one-kilometer-square area if the units were micrograms per cubic meter and the contaminant carbon monoxide. In metropolitan Phoenix, the levels would be a factor of 50 higher for the yearly average.

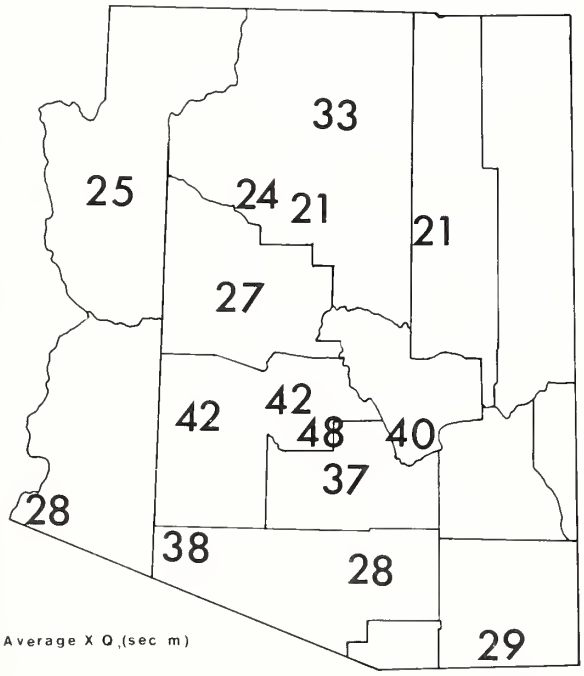

Figure 13.--Annual average urban χ/Q, seconds per meter. Relative values shown for a one-kilometer-square emissions area.

The highest local concentrations on an hourly average basis can be determined from the equations in the references. In general, these will be 100 times higher for the point sources at the location of maximum ground level concentrations. For such calculations, the wind is assumed to blow in the same direction for the entire time and the breakup is accompanied by unstable mixing conditions. Actual inversion breakup occurs with variable winds, but maximum pollution concentrations would occur at the time of breakup. Since early morning inversions are present over 90% of the time in all parts of the state, this problem exists equally throughout Arizona.

Airshed Modeling

Many of the aspects of urban airshed modeling are discussed by Seinfeld, Reynolds and Roth (1972). Here we want to look at some results and the application to pollution potential. A complete study includes solving the equations of motion, energy and mass transport for the airshed in question. In general, this is not possible at present so the wind field and energy effects must be known. For simulation of a current day or series of days, the emissions amounts and distributions are also known. For prediction of future concentrations, the emission amounts and locations are forecast and used also as known quantities. Then modeling programs solve for concentrations throughout the airshed numerically. These programs use some approximation for the turbulent vertical mixing usually related to atmospheric experiments.

When terrain effects on the wind field are pronounced, some form of airshed modeling is necessary for urban areas. The success of this type of modeling is dependent on extensive knowledge of the local wind field. Information on Phoenix was gathered by Berman and DeLaney (1975) and used in a "box model" to show the distribution of carbon monoxide in the Phoenix area during a typical winter day when no fronts influenced the weather. A box model uses a lid on the valley with pollutants well mixed below the lid. The lid height can be varied with

time to account for changes in mixing from the stable (limited mixing) inversion at night to the unstable midafternoon. Carbon monoxide is produced almost entirely by automobiles so the emissions vary during the period of the simulation also.

Results are computer maps as shown on figures 14 and 15. Some pockets of high pollution potential can be pinpointed on these maps and in Phoenix show up in the summaries of monitoring sites. We found that the weakly developed upslope winds were an important factor leading to high concentrations of carbon monoxide and these winds were much less important on the measured wind direction distribution. The weak upslope winds were unable to push the pollutants generated in the central part of Phoenix over the low mountain barriers to the north, so the concentration would build up after sunset when limited vertical mixing began. Figure 14 shows the concentrations near their peak level and figure 15 shows the cloud moving out of the valley along the drainage winds.

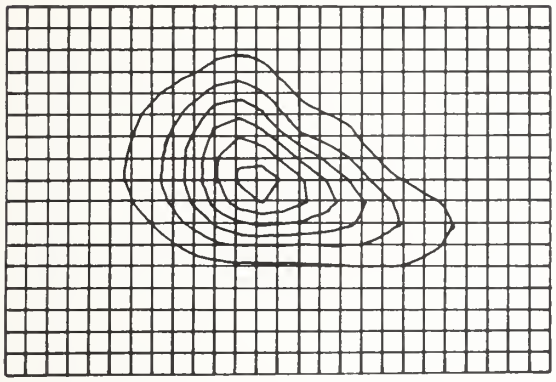

Figure 14.--Carbon monoxide concentrations in the greater Phoenix area on November 26, 1974. Average between 8 and 9 p.m. Innermost area has over 19 parts per million (ppm).

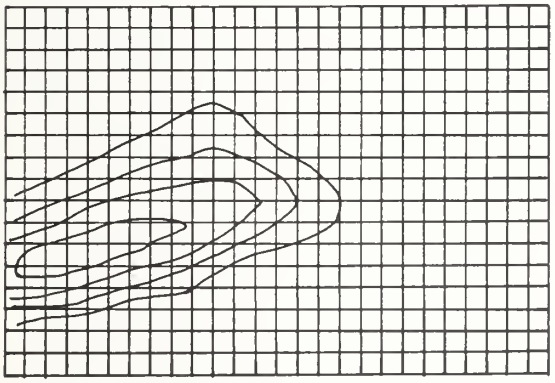

Figure 15.--Early morning (3-4 a.m.) concentrations of carbon monoxide in Phoenix. Innermost area is over 4 ppm.

Comparison of the computer model with measurements near downtown Phoenix are shown in figure 16. Such airshed studies can be used for rural areas and the cost for simple models is comparable to that for the Gaussian Plume Analysis.

The detailed analysis can also be used to show the importance of transport and production mechanisms at any location within the grid. Figure 17 shows the results for the maximum emission location in Phoenix. When the night wind is dominant, most of the carbon monoxide found at this location comes from upwind areas. During the afternoon and evening when the day wind is present, most is produced within the area itself and remains. Note that the switch occurs precisely at the time of wind reversal, approximately 8 p.m.

When pollutants must be tracked on an hour-to-hour basis, airshed modeling can give excellent results. Although we have discussed one particular day, this day represents one of the worst in Phoenix in the 1974-75 winter. The

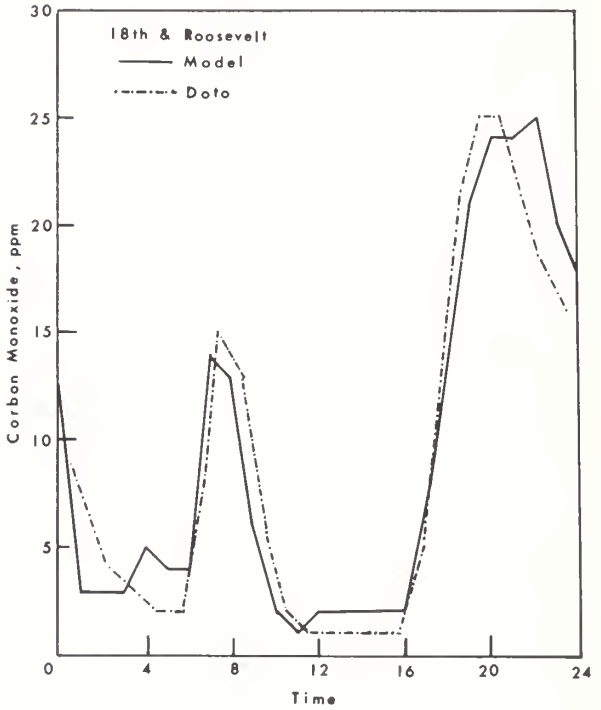

Figure 16.--Comparison of computer model carbon monoxide concentration with measured data at 18th and Roosevelt location in Phoenix, Arizona.

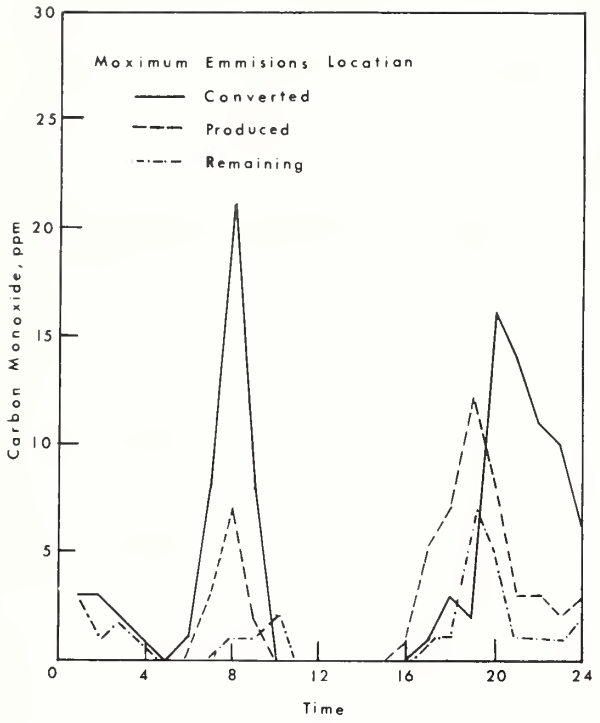

Figure 17.--Transport mechanisms in the grid square responsible for the maximum emissions from automobiles in Phoenix. (November 26, 1974 simulation.)

wind height variations with time are representative of days with potentially high carbon monoxide levels at times in the future. If we feed projected automobile emissions for the future into the model, the airshed technique can be used to predict air pollution potential and aid in planning.

CONCLUSION

In this report, summaries of current and potential air pollution in Arizona have been presented. This work represents a considerable improvement over previously available wind speed and mixing height tabulations for the evaluation of sites in the state for industrial or housing development. The abrupt change in wind direction north to south across the entire state and early morning inversion depth east to west across the southern half of the state need more clarification. Studies are needed in the Mogollon Rim area; between Phoenix and Yuma; and in the southeast part of the state to provide improved maps which can be used to estimate air pollution potential.

ACKNOWLEDGEMENTS

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Evaluation of Impacts of Various Recreation Uses on Air Quality in Northern Arizona: The Scenic Suburban Forests and Their Aesthetic Values[1]

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Abstract.--The impact of human activity related to the aesthetic values is discussed with respect to suburban forests. Air quality in various recreation areas of Northern Arizona is reviewed. The visibility as a means for measuring manmade pollutants is reported for various recreational areas. A simple and inexpensive ion method for detection of pollutant build-up in nonurban areas is explored.

INTRODUCTION

The role of the recreation residential homeowner in the local community in many areas of the United States is an increasingly important one. With the effects of higher disposable incomes, shorter working weeks and better transportation, the significance of this segment of the leisure industry will increase much more rapidly in the future, Snyder and Adams (1967). The primary agent that contributes to the demand for recreation homes is our rising national productivity. It has enabled us to increase our material standard of living while at the same time making it possible to have leisure time for play, relaxation, enjoyment, and personal self-fulfillment, Clawson (1967).

At the same time, there is occuring a growing emphasis on a life-style that emphasizes physical fitness, scenic beauty, and a return to nature. Many of these vacation-recreation homes are havens from hectic urban life. They are relaxing places where people come for emotional renewal and physical rest. For those who are activity oriented, these homes are nothing more than refueling stops, (Outdoor USA, Yearbook of Agriculture, 1967). For others, the recreation home is a culmination of a lifetime of work. U.S. News and World Report, (1969), a leading news reporting magazine, reported results of a survey that best sum up the magnitude of the recreation home movement. The two items in the leisure industry that have experienced the most rapid growth between 1967 and 1969 were second homes, with a 67 percent increase in investment, and vacation land and lots with an 86 percent increase in investments.

Investigations of the air quality and recreational areas of Northern Arizona has influenced the writer to consider not only air quality but also other factors relating to the entire ecological problem which surround these areas. Basic examination of the quantity and types of air pollution has influenced the approach taken in this paper.

Population Increase

By the year 2000, the population of the United States is expected to reach approximately 293.5 million people. Some estimates indicate that it will be as high as 321 million. Unfortunately, many of the projections made in the past regarding expected population increases have been low. Even if the lower estimate proves to be more nearly correct and we attempt to maintain our current standard of living and life styles, the implications with respect to our natural resources are staggering.

Pressure on Natural Resources

In the United States, we are blessed with a greater quantity of natural resources of many kinds than many of our less fortunate neighbors. In addition, the rate at which our population is increasing is well below the alarming rates of increase in many other countries. In spite of these facts, our

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exceedingly high level of consumption in the United States has created a dependency for natural resources on many other countries around the world and we are already beginning to experience rather severe problems and pressures in many areas.

Not the least of these are demands being placed on land, including suburban forest land. Former President Lyndon B. Johnson expressed concern about certain of these pressures in his 1965 White House Message on Natural Beauty when he said, "A growing population is swallowing up areas of natural beauty with its demands for living space, and is placing an increased demand on our everburdened areas of recreation and pleasure."

Along with the unprecedented growth in many urban areas, there is an accompanying redistribution of urban populations in progress. The "flight to the fringe" from the urban core or "urban sprawl" is, paradoxically, an attempt to by many segments of the population to surround themselves with natural beauty, not swallow it up. These people are meeting with varying degrees of success and the natural beauty they seek is frequently the countryside with its forests.

The Problem as Related to Forests

Our forest lands have not been, and certainly will not be exempt from the demands of an increasing population. In fact, our forests will have to bear much greater pressure in the future than many of our other natural resources. Many of these pressures are and will continue to be the consequence of persons invading forested areas seeking places of residence, recreation and relaxation. In addition, these forests will be dissected by the highways needed to transport these people to jobs, schools, and the like.

Other Demands

In addition to supplying timber, forests are expected to provide habitat and food for many of the wildlife species we harvest or otherwise enjoy, protect our watersheds, heal abused land and grace our landscape. The forest is a place where we camp, ski, hike, picnic, and pursue a host of other recreational activities. We seek privacy, solitude, and relief from extremes in the weather in the forests. In the opinion of many, forests present physically relaxing and mentally refreshing conditions which are taking on greater and greater importance in the fast moving world in which we live. These and other uses were already recognized and discussed during the Forest Land Use Conference in 1961 (American Forest Products Industries, Inc., 1962).

One aspect of the overall problem of increasing pressures being placed upon our land is that, in light of our present attitudes and methods of management, not all the uses demanded of the forest land are compatible. We simply cannot have everything from and do everything in the same piece of land at the same moment in time.

An aspect expressed by Garratt (1961), in that "Today's forest acreage is more than we shall have in the future." He cites statistics which indicate that in spite of the reversion of some agricultural lands to forest, the area of commercial forest land has declined from 525 million acres in 1900 to 489 million acres at the time of the conference, 1961. Should this trend continue, it will only serve to compound existing problems.

The U.S. Forest Service, approaching this aspect a bit differently, reports that by the year 2000 and particularly in subsequent years, substantial areas of forest land could be lost to uses other than wood products production.

Outdoor Recreation

This country is presently experiencing an outdoor recreation boom such as no one has seen before. This is certainly not restricted to Arizona forests but the problems that result are more acute in the East. Camping, skiing, motorcylcing and snowmobiling have exploded into the outdoor recreation arena. Motorized vehicles have rendered what were relatively inaccessible areas almost as accessible as an individual's back yard.

Still other recreation interests compete for a place in the southwestern forests. Picnicking, hiking, nature study, hunting, field archery and fishing are some of these interests.

Two things can be inferred regarding this surge in outdoor recreation. First, it should serve as some kind of index regarding the affluence of our society. Babeau, Rhodes, and MacDonnell (1965) stated, "Because many woodland owners in the county enjoy a good high income, it appears that insufficient capital is not an obstacle to management in most cases." Even the well-managed woodland of relatively small size provides little annual income when selectively managed on a

10 to 15 year cycle.

Second, while an increased number of individuals are viewing the suburban forest in the light of wood products production, an even larger number of individuals and industries are concerned about the suburban forest as an environment for outdoor recreation.

This whole problem in Northern Arizona has been dramatically emphasized by the conflict of interests concerning the development of the Hart Prairie land.

AESTHETICS

Importance of Aesthetics

We have seen the term "aesthetics" appear more than once in recent and current thinking about recreation forest management. It has been judged important in connection with small forest landowners (Hamilton, 1966), the suburban forest (Spurr, 1962), and the urban forest (Goddard, 1969).

At this point it might be well to define the term "aesthetics." Bullough (1957) credited Baumgarten as being the "father of aesthetics." Baumgarten's definition which appeared in the 1750's literally meant "to test likes and dislikes, pleasure and displeasure."

Definitions like the preceding only lead to further difficulty when one tries to define pleasure, beauty, and the like.

President Johnson (1965) said:

> Beauty is not an easy thing to measure. It does not show up in the gross national product, in the weekly pay check or in profit and loss statements. But these things are not ends in themselves. They are a road to satisfaction and pleasure and the good life. Beauty makes its own direct contribution to these final ends. Therefore it is one of the most important components of our true national income, not to be left out simply because statisticians cannot calculate its worth.

For each individual the meaning of aesthetic or beauty is somewhat different, and while there are broad areas of agreement, and while there are probably as many areas of disagreement as to what is pleasant or beautiful.

Odum (1962) in discussing the ecological roots of aesthetics, said:

> Deep within man's physical and cultural inheritances are environmental preferences that create strong desires even in modern times. One may speculate about instinctive drives and their possible significance for survival in the former eras when man's energy supplies were ecologically different.

Kates (1966) suggests that it might be easier to identify that which is ugly than that which is beautiful and defines ugliness in terms of what it can do rather than what it is. He states, "That which is truly ugly has the power to destroy for us the pleasant and agreeable. The key to this destructive power is the misfit."

The lack of control of the homes and second homes in and near recreational areas (National Forests), along with the visable air quality is a destructive force in maintaining the beauty of the area, "misfit."

Concern for Aesthetics

It is encouraging to note that the concern for aesthetics has appeared within certain of the federal agencies concerned with the management of the nation's forest recreational lands. Eyer (1965) said that the Bureau of Land Mangement allows for departures from standard procedures for the sake of asethetics.

The U.S. Forest Service is vitally concerned about trying to reconcile the conflicts created by the multitude of demands being placed on our recreational and forest areas. The Forest Service is showing an increased concern for aesthetics.

Lynch (1966) indicated that the national forests have a series of classified recreational categories that require modified silvicultural treatment. These range from intensively used camp grounds to high mountain areas and include wilderness areas where no logging is permitted.

Neighborhood Growth

Housing construction is taking place in Northern Arizona city neighborhoods, and this trend is expected to continue. However, the scarcity of vacant land in existing residential areas has given rise to the planning of new neighborhoods.

Hoff and Shahen (1973) have made a study of this problem in the Flagstaff area. The areas include three within the city limits: Switzer Terrace, Continental Country Club, and University Heights; and four areas within commuting distance of Flagstaff: Kachina Village-Mountainaire, Pinewood, and Fort Valley. These neighborhoods are not the only developments planned in Flagstaff, but they are expected to have a major impact on the scenic beauty in and near the recreational areas.

Kachina Village.

Kachina Village is located five miles south of Flagstaff off U.S. Interstate 17. The area is surrounded by Coconino National Forest. Construction began in 1965.

At the present the development has 80 families who reside there year-round. During the summer months up to 150 families are located in the area. The development has 1,500 acres with current plans calling for 2,000 lots in the development, ranging in size from 1/4 to 2 acres. The development plans for 1/3 of its lots to go for mobile homes and 2/3 for homesites.

The development is primarily a second-home resort area. On the development site is a lodge, recreation area for children, fishing lake, horseback riding and swimming pool.

Pinewood

Pinewood is located 18 miles south of Flagstaff, off U.S. Interstate 17, surrounded by Coconino National Forest. Construction began in 1968.

Currently the area has 650 units, of which 150 are mobile homes. Pinewood is currently a second-home resort development. The development provides a 18-hole golf course, restaurant, swimming pool, children's playground, youth center, and stables.

Fort Valley

Fort Valley an early homestead area, is located six miles northwest of Flagstaff off U.S. Highway 180. The area is surrounded by Coconino National Forest. Construction of homesite began early in the 1960's.

At the present the development has 50 families who reside there year-round. During the summer months up to 100 families are located in the area. The development has nearly 1000 acres. It is a sprawling development located at the base of the San Francisco Peaks on both sides of U.S. Highway 180.

The development is both home and second home area.

Photos 1 and 2 illustrate the variance in compliance to the aesthetic beauty and the poor construction which damages the aesthetic value in the areas.

Photo 1

Photo 2

AIR QUALITY - RECREATION AREAS

Visibility Degradation and Air Pollution

Perhaps one of the most significant effects of air pollution is an acute degradation of visibility caused by it. The problem of visibility degradation as a function of atmospheric mass loading has been investigated extensively. Generally, the approach has been to try and correlate the local mass loading due to suspended particulates with the observed visibility or some measured value indicative of visibility such as a light scatter coefficient. Since most of the studies find good correlations between the aerosol mass loading and visibility, it seems logical, that under certain conditions visibility data can be used as a reasonable tracer of the larger scale advection of suspended pollutants. Therefore, the relationship of visibility (and degradation of it) to aerosol mass loading is examined.

The effects of air pollutants on visibility are actually the results of the variations in radiation caused by them. Suspended particulates in the atmosphere, as well as gaseous molecules, cause visible radiation to be scattered or absorbed. In general, light passing through a polluted mass will be characterized by some attenuation. In the case of an observer viewing an object at a distance, the contrast between the object and its background is what is perceived. The main limiting factors in the perception of an object are the distance between object and observer, the illumination of the object, and the alteration of light intensity along the sight path due to the absorption and scattering of the light. The greatest distance at which an object can be seen (at which a perceivable contrast exists) is the visible limit. This limit is often referred to as the visibility. However, visual range or meteorological range are probably more correct. Although the terms visual range, meteorological range, and visibility are often used synonomously in the literature, they actually mean something different.

According to The Glossary of Meteorology (1959):

Visibility--In United States weather observing practice, the greatest distance in a given direction at which it is just possible to see and identify with the unaided eye (a) in the daytime, a prominent dark object against the sky at the horizon, and (b) at night, a known, preferably unfocused, moderately intense light source. After visibilities have been determined around the entire horizon circle, they are resolved into a single value of prevailing visibility. There are inherent difficulties with the conventional requirement that visibility markers be both detected and identified. If the recognition requirements are dropped, the visibility could be defined as a subjective estimate of visual range.

Visual Range--The distance, under daylight conditions, at which the apparent contrast between a specified type of target and its background becomes just equal to the threshold contrast of an observer.

Meteorological Range--An empirically consistent measure of the visual range of a target; a concept developed to eliminate from consideration, the threshold contrast and the adaptation luminance, both of which vary from observer to observer.

From the above definitions, it is seen that the meanings of these different terms are actually quite similar. Meteorological range represents the most objective measure, and is often referred to as standard visibility or standard visual range. The concept of meteorological range is generally used as the basis in studies attempting to correlate visibility with pollution. However, since visibility is a good subjective indicator of actual meteorological range, the synonomous use of the terms is readily acceptable.

The meteorological range, Middleton (1952) has been defined as that distance at which the contrast between an object and the background has decreased to 2% of the contrast observed when the object is close at hand.

Contrast is defined in terms of the brightness B of the object and the brightness B' of the background by the equation

$$C = (B-B')/B' \qquad (1)$$

When the object is close, the contrast is

$$C_o = (B_o - B'_o)/B'_o \qquad (2)$$

and when the object is at a distance equal to the visible range, the contrast is C_r is

$$C_r = (B_r - B'_r)/B'_r \qquad (3)$$

and C_r is 1/50 C_o.

Visibility Studies in the Grand Canyon*

Middleton (1952) discusses many ways of determining the visible range including using available landmarks and backgrounds. The system to be described here uses a laser beam of known brightness operating against a background of essentially zero brightness (i.e. $B_o' = 0$). By measuring the amount of light in the beam at a known distance from the source, one can determine the visible range. For the system to operate properly, there are three conditions one must consider:

1) The background light must always be zero whenever and wherever the beam power is measured.
2) All the power in the beam is collected when measured at both close range and far range.
3) The light scattered out of the beam is not collected when the beam power is measured.

Condition (1) can be satisfied by using interference filters of very narrow bandwidth. However a better method is to use a beam whose intensity is varying in time. Using a moderately high frequency of modulation of the intensity, it is possible to block out the essentially steady background lights as well as the low frequency man made lights. In addition, AC techniques of amplification of the signal from a weak laser will give a usable output signal.

Condition (2) can be satisfied by using a collimated beam of a single wave-length. With this it is possible to keep the light energy in a small enough beam so that it can be entirely collected using not unreasonably expensive lenses or mirrors.

Condition (3) is more complex and actually has two parts. First, the beam power reading coming from scattered light of the collector has a large aperture. Second, some of the light scattered out of the beam could be scattered back into the collector if it has a large field of view. If the collector is not too large and is collimated so that it accepts parallel light, or nearly so, condition (3) should be satisfied.

Grand Canyon System

The system that has been devised for measurements made at the Grand Canyon consists of a He-Ne laser modulated on and off at a frequency of about 5,000 Hz using a mechanical chopper. This laser has a wavelength of 632.8 nm and an output power of about 3.5 milliwatts. The small diameter beam from the laser is expanded to a collimated beam of about 6 inch diameter. The central 3 1/2 inches of the beam is blocked by an obstruction in the colliamtor thus giving a ring of light as the output. The total power in this ring is about 0.1 milliwatts. The entire apparatus is mounted on a concrete pier and alignment of the beam is accomplished with micrometer adjustments. This system is located in a building near Phantom Ranch at the bottom of the canyon.

The beam from the transmitter is sent 5.2 km to the top of the canyon, 1500 meters higher, and into a cave located just below Yavapai Museum. A beam collector is located here and consists of a 16 by 24 inch Fresnel lens of 24 inch focal length which focuses the energy collected onto a 1 inch diameter solar cell. The electrical output from this cell is sent to a system that electronically filters the 5000 Hz signal, amplifies it, converts it to a DC signal, and sends it to an inkless recorder.

The Fresnel lens is small enough to satisfy condition (3) and yet large enough to satisfy condition (2). With the AC signal, condition (1) is satisfied.

With this system, the visible range is that distance at which the beam power has fallen to 1/50 of the beam power at the transmitter. In general the beam power decreases with distance according to the equation.

$$P = P_0 \exp -\sigma x \qquad (4)$$

Where σ is the extinction coefficient and x is the distance from the transmitter. The extinction coefficient is made up of two parts, the absorption σa and scattering σs coefficients, Middleton (1952),

$$\sigma = \sigma a + \sigma s \qquad (5)$$

At some fixed distance D, a measured transmittance $T = P/P_o$ will yield

$$T = \exp -\sigma D \text{ (sa) or } \sigma = -\ln T/D \quad (6b) \quad (6)$$

The visible range is that distance at which T is 1/50, or

$$1/50 = \exp -\sigma R \qquad (7a)$$

or

$$R = -\ln 0.02/\sigma \text{ or } R = \ln 50/\sigma \quad (7b)$$

* Direct consultation with K. O'Dell , R. Layton and W. Willis, Physics Department, Northern Arizona University.

or, using equation (6b)

$$R = -D \ln 50/\ln T \quad (8)$$

Results of Grand Canyon System

The system described has yielded many short periods of good results over the past two years in the Grand Canyon. The transmittance over the 5.2 Km path is approximately 82% which corresponds to a visible range of about 100 km. In April, 1973 one measured transmission was less th an 92% for a visible range of at least 240 Km. Most of the extinction coefficient is probably caused by scattering from dust. Additional information about the causes of the extinction could be obtained by using a two wavelength system and by sampling the material in the air. The transmitter is designed so that a blue laser could be installed without altering the present setup. This laser would be modulated at a different frequency so that its signal could be separated electronically. Because of the higher cost and shorter life of this laser it must operate for short periods but simultaneously with the red laser and with the same collimator. The red laser would then be used for continuous transmission measurements, with additional information coming periodically from the blue laser. In addition to the laser measurements, air sampling along the path and chemical and physical analysis of the collected samples would give information on the kind, amount, and size of the particles causing the extinction.

The laser system is designed to operate on a continuous basis with the other measurements being made periodically. Two major problems have been encountered with the present system, however, and require some discussion. First, the lasers have been found to be not as constant in their output as is desired, and so an output monitor or some electric system must be used to stabilize the output. Second, the beam alignment cannot be maintained due to atmospheric refraction. This can also be corrected by electronically controlling the beam alignment, or the collector position. Other solutions to this problem exist but they are most costly, and at the present time are under consideration.

Additional Experiments

Additional information being gathered to be used in conjunction with the laser data include, weather data at the bottom and top of the Canyon, and on the Tonto Platform, also high volume sampling and analysis at the bottom of the Canoyn. Other information being gathered include continuous atmospheric conductivity and Aitken nuclei counting. The conductivity measurements at this writing indicate very clean air at the bottom of the Canyon. It is hoped that a correlation will exist between the data and the laser results.

A Comparative Visibility Study

In this study Hall and Riley (1975) used astronomical photometric techniques to determine the atmospheric visibility over horizontal paths of several kilometers and in the wavelength domain bounded by ozone and watervapor absorption (0.32 to 0.66 um).

The had three objectives in mind. 1) To determine very accurate extinction coefficients (visibility) first at Flagstaff, and then in other areas of different elevation in the United States where clear air is most likely to be found, in order to establish an early-warning system for the detection of manmade pollutants. 2) To determine, if possible, the nature of the aerosols responsible for the extinction observed in each environmental situation. 3) To find a simple means of making accurate measurements of both background intensity and extinction in full daylight for the purpose of determining reliable and objective values of visibility.

Most of the measurements presented in their paper represent data obtained under various conditions within the City of Flagstaff (elevation 2.2 km). A few spectrophotometric measures made at Gila Bend (0.2 km) are also presented.

Flagstaff Measurements

Observations were made at Flagstaff in the Fall of 1973 with two light sources with a difference in distance of 3.32 km. The light path was about 100 meters above a residential part of the City in a northeasterly direction from the Lowell Observatory at an elevation of 2.18 km.

Gila Bend Measurements

Portable equipment was used to make visibility measures at an elevation of 0.2 km on grazing land fifteen miles west-northwest of Gila Bend in southwestern Arizona.

The data observed on two occasions at this site include one when a dust storm was in progress, and the next when the visibility by the naked eye was very good.

The dust storm encompassed an area of hundreds of square miles.

Findings

They found under favorable conditions a visibility (a scale distance) over the City of 55 km while that found at Gila Bend during clear weather to be 25 km. During the dust storm the visibility (scale distance) was about 2.1 km. The mountains 6 or 7 km away during the dust storm could not be seen.

Burning of slash by the Forest Service several miles to the north of Flagstaff was easily detected. The change in visibility from burning depended greatly on meteorological conditions. To be reliable these measurements require additional research.

LAKE POWELL RECREATION AREA

Lake Powell Research Project

The Lake Powell Research Project is a consortium of university groups funded by the Division of Environmental Systems and Resources in RANN in the National Science Foundation.

Researchers in the consortium bring a wide range of expertise in natural and social sciences to bear on the general problem of the effects and ramifications of resource management in the Lake Powell region. The region currently is experiencing converging demands for water and energy resource development, preservation of nationally unique scenic features, expansion of recreation facilities, and economic growth and modernization in previously isolated rural areas.

In the Lake Powell region, concern about the conflict between maintaining environmental quality and developing coal-fired thermal-electric generating stations has led to measurement of present air quality to provide a reference for determining future changes. In addition to powerplants, other air pollution sources of less concern but no less importance to the existing air quality in the area include automobiles, motorboats, long-range transport, and blowing sand.

Walther, et.al. (1974) defined air quality in terms of constituent aerosol, gases, and integrated characteristics. Measurement sites and methods are described and evaluated.

Construction of Glen Canyon Dam on the Colorado River led not only to the birth of Lake Powell but also to creation of the nearby construction towns of Page, Arizona, and Glen Canyon City, Utah.

The rise in the level of Lake Powell since its creation in 1964 has been accompanied by an increase in recreational use, involving both automobiles and motorboats. The assured supply of cooling water available in Lake Powell is allowing construction of the 2,310-megawatt Navajo Generating Station near Page, Arizona. The municipalities, automobiles, and motorboats are superimposing their effluents on the background air quality of the region. Of course, the background air quality also changes, without the direct influence of man, by the natural variation of wind-blown dust, emission of terpenes by vegetation, and weather.

An evaluation of the background air quality, its variation, and the air quality change caused by man's activity on and around Lake Powell is necessary to determine the impact of the impoundment and its resulting activities upon the quality of life in the Lake Powell region; the effect of resultant air quality upon the Lake Powell recreational area; and interactions between the atmosphere and the lake. Visibility is the most obvious example of an air quality parameter which is crucial to the recreational value of the Lake Powell area. If man degrades visibility there, the recreational value may similarly be degraded.

Air Quality

Concerning the air quality portion of the Lake Powell Study specifically, the Bureau of Mines and the U.S. Geological Survey analyzed the chemical compositions of the various coals in the region. The utility companies provided information on the designs of existing and planned coal-fired thermal-electric generating stations, including rates of coal consumption, furnace design, air pollution control devices, and expected stack emissions. EPA calculated the prevalence of stack emissions while NOAA developed a model of atmospheric dispersion. Combining these efforts, the expected ground-level concentrations were calculated at various locations and under various meteorological conditions. The important meteorological conditions are wind velocity and atmopsheric stability, the latter depending on the wind speed and temperature variation with elevation above ground. Under the worst conditions of low wind speed, high terrain nearby, and limited mixing of the atmosphere, some of the calculated maximum ground-level concentrations

were calculated at various locations and under various meteorological conditions. The important meteorological conditions are wind velocity and atmospheric stability, the latter depending on the wind speed and temperature variation with elevation above ground. Under the worst conditions of low wind speed, high terrain nearby, and limited mixing of the atmosphere, some of the calculated maximum ground-level concentrations exceed certain Federal ambient air quality standards for sulfur dioxide (SO_2) and nitrogen dioxide (NO_2).

The air quality portion of the study also reported on the reduction of visibility caused, at that time, by existing powerplants, particularly the Four Corners Power Plant (located several miles west of Farmington, New Mexico), and predicted more such problems, emphasizing the close proximity of the Navajo and of the Kaiparowits Generating Stations to Lake Powell. The Study's contention that the plumes from these latter two generating stations would interact and cause an air quality problem worse than that from two such plants isolated from each other was debated by several meteorological consultants to the utility companies in the Joint Meteorological Report (Dames & Moore et.al., 1971). These consultants concluded from the available meteorological data that the topgraphy of the Southwest would separate some of the powerplants from each other in areas called "airsheds." An airshed is that volume of atmosphere over a defined area of land in which the air pollutants from groundlevel sources are reasonably well-confined, even though the overall air flow passes from one airshed to another with the prevailing winds. According to the definition of specific airsheds in the Southwest used in the Dames & Moore report, the Navajo and Kaiparowits Generating Stations would both occupy the same airshed around lower Lake Powell. Yet analysis of wind velocity distributions led the authors of the report to conclude that the plumes from the two powerplants would rarely combine to produce a greater effect on air quality than would the plume from each alone.

Conclusion

There is no clear consensus on the expected effect on air quality from the emissions of powerplants under construction or from those to be built near Lake Powell. In their report, they define the present air quality of the region, using their own measurements and those of others, taken before large air pollution sources such as the powerplants actually began operating. In this way, it is possible to provide reference values for any changes in air quality.

The results of their measurement program show that the air is clean in the Lake Powell region. Generating stations already in operation, such as Cholla and Mohave, have affected the concentration of aerosol and its sulfate component. Remote areas near Page are so clean as to be near or at the limit of instrumental measurement. The excellent average visibility of about 200 km (124 miles) in the Lake Powell region is in stark contrast to the visibility in our major cities, and by Lowell Measurement even in Flagstaff, the largest city in Northern Arizona.

Definition of Air Quality

Air quality is determined by measurement of aerosol, gas concentration, noise, radioactivity, turbidity, and visibility (Table 1).

The constituents of air comprise aerosol and gases. Aerosol consists of all those solid particles and liquid droplets that range in diameter from about (20 Angstroms (A) to 100 microns (μ). There are four important aerosol parameters: chemical composition, size distribution, number concentration, and mass concentration. The first is chemical composition, which usually varies with the aerosol size. The health significance of

Table 1: Air Quality Parameters

1. Aerosol
   - a. Composition
   - b. Concentration
     - i. Mass
     - ii. Number
   - c. Size Distribution

2. Gas Concentration
   - a. Ammonia (NH_3)
   - b. Carbon Monoxide (CO)
   - c. Hydrocarbons (HC)
     - i. Alkanes
     - ii. Alkenes--Terpenes
   - d. Hydrogen Sulfide (H_2S)
   - e. Nitrogen Sulfide (H_2S)
   - f. Nitric Oxide (NO)
   - g. Oxidant
     - i. Ozone
   - h. Sulfur Dioxide (SO_2)
   - i. Water Vapor (H_2O)

3. Noise

4. Radioactivity

5. Turbidity

6. Visibility

aerosol depends both on its size distribution, which determines the distribution of aerosol deposited in the respiratory tract, and on its chemical composition, which determines the health effect of a particle once it is deposited on the wall of the respiratory tract. The aerosol concentration may be measured in terms of either *number* per unit volume of air or *mass* per unit volume of air. Additional information is contained in the parameter size distribution, which is the number or mass concentration in several size intervals within the overall size range. In the Lake Powell area, up to 1974, aerosol had been generated mostly by automobiles, motorboats, and blowing sand; after June 1974, the 2,310-megawatt coal-fired Navajo Generating Station became another source of aerosol.

The Arizona State Department of Health Services (ASDHS)(1972), includes the following constituents in its analysis of aerosol composition: benzene-soluble component, nitrate, sulfate, arsenic, bismuth, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, tin, titanium, vanadium, and zinc.

Among the gases listed in Table 1 as air quality parameters, the following are of obvious significance for national ambient air quality standards: carbon monoxide (CO), hydrocarbons (HC), nitrogen dioxide (NO_2), oxidant, and sulfur dioxide (SO_2). Nitric oxide (NO) is listed because it is the important precursor of NO_2. Hydrocarbons are divided into various types because of the importance of (1) methane, an alkane, to the total hydrocarbon concentrat ion and (2) ethylene and terpenes, all alkenes, to anthropogenic and natural sources of reactants in gas-to-aerosol conversions and in photochemical reactivity in general. Water vapor is listed here as an air quality parameter amongst the gases, even thought it is usually listed as relative humidity, the meteorological parameter, because it determines the aerosol size distribution for an otherwise specified aerosol chemistry. Ammonia (NH_3) and hydrogen sulfide (H_2S) are present in extremely low concentrations. They play a role in the nitrogen and sulfur cycles, and NH_3 can help convert SO_2 to sulfate (SO_4). The specific gases (listed in Table 1) chosen as air quality parameters are emitted by both natural and anthropogenic sources and these gases are considered to be the most important with regard to the health of regional biota and the welfare of man. The main sources of CO, HC, and NO_2 around Northern Arizona are automobiles and motorboats. The terpene class of hydrocarbons comes from aromatic vegetation. Oxidant is produced naturally, but sources of HC and NO_2 lead to specific photochemical reactions that may produce additional oxidant. The only significant sources of SO_2 is Power Generating Stations. They are also a significant source of NO and NO_2.

Although noise is not usually considered as an air quality parameter, it is included here because (1) it is so important to the aesthetic quality of the environment around recreational areas; (2) it will increase with increasing population, industry, and recreation (motorboats); and (3) it is transmitted through the air medium.

Radioactivity in the atmosphere is carried by gases and aerosol. Total beta-activity in the aerosol collected on a filter with a high-volume sampler at Page in 1969 was low enough to indicate to the Arizona State Department of Health that there was no threat to health and that such measurements could be suspended. Testing of underground nuclear devices in Nevada may be an occasional source of leaked radioactive contamination in the region, and is capable of elevating the radioactivity of the atmosphere above the background level for a relatively short period of time. Since coal contains radioactive elements, both the Navajo and the proposed Kaiparowits Generating Stations.

Turbidity is the atmospheric aerosol loading that attenuates incident solar radiation by scattering and absorption. Turbidity is quantified by a coefficient, defined as

$$B = \frac{\log_{10} \frac{I_o}{sI} = bM}{M_h} - k$$

from the transmission equation

$$I = \frac{I_o}{s} 10^{-(B + k)M_h - bM}$$

where I = incident solar radiation intensity

I_o = extraterrestrial solar radiation intensity

s = correction factor for actual solar distance compared to mean solar distance

k = absorption coefficient for ozone

b = scattering coefficient for air

M = absolute air mass along observing path = $\frac{P}{P_o} M_h$

P = ambient pressure

P_o = sea level pressure

M_h = relative air mass

Visibility is defined in some detail in the Grand Canyon Study.

VISIBILITY AND SMALL-ION DENSITY

The electrical properties of atmospheric air at low levels depend mainly on the mobility and the nature of small ions. An important factor in determining the concentration of small ions within exchange layer is the presence of other comparatively heavy airborne particles which do not contribute to the now of electric current directly but upon which small ions can recombine to destroy carriers of electricity. Even above the exchange layer the effect of such aeorsol particles on the small-ion concentration is noticeable. It is not strange, therefore, that many investigators have noted a decrease in ion density when clouds, fog, or haze is present.

The study of airborne particles is important to investigators of atmospheric electricity, and it has also been the focal point of many other disciplines. One major characteristic of airborne particles is their ability to scatter light and thus reduce visibility. For this reason it seems to be quite natural that a relationship exists between the electrical and optical properties of a turbid atmosphere.

Several papers, experiments and reports have been published to establish under some simplifying assumptions the light-scattering process with the process of ion attachment. The similarity seems most obvious for geometric scatters in an atmosphere where the mean free path is large in comparison with the particle diameter. This situation is applicable not only for particles of noctilucent clouds, but even at ground level for haze and fog particles. A fair correlation should exist between the scattering coefficient and small-ion density. Serbu and Trent (1958) and Reiter (1956) observed electric fields, conductivity, and visibility conditions particularly during periods of fog. They found emperically that the presence of fog can be derived and even predicted from electrical measurements. We feel his technique can be applied to other pollutants of very small diameters. Minton (1960) has gone so far as to establish forecasting rules for fog and other pollutants, using electric field and conductivity data.

In the past five years dramatic changes have taken place in the utilization of private land located within National Forests. Many unused land parcels are being developed into second home complexes. Over the past several months the writer has observed a gradual degradation of the visibility and aesthetic beauty of the forest areas adjoining the expanding home development areas. The type of pollution does not appear to be the same as that found in the Los Angeles and/or Phoenix areas. It is quite impossible to make predictions for the development of second home areas and the continued aesthetic beauty of the forests without a basic understanding of the pollutants causing a degradation of the clean air. The objective of this research project is to determine the amounts and kinds of pollutants which are having an effect on the aesthetic beauty of the scenic Forest areas, and to establish background data for visibility in these areas.

SUMMARY AND CONCLUSIONS

A search of the literature indicates that the recreational use as well as the economic value of scenic urban forests is rapidly becoming a critical problem throughout the United States. The lack of control in building and managing second home areas in and adjacent to national forest recreation lands is rapidly deteriorating the aesthetic values for users of these controlled areas for rest and relaxation. This has been a concern for about the last fifteen years--with former President Johnson in 1965 speaking in defense of preserving our suburban forests.

The investigation of the air quality of Northern Arizona leads directly to a factor in aesthetics--namely, visibility. According to the weight of authority, visibility is a definite indicator of the degree of pollution in the area.

It is gratifying to report that the major recreation areas in Northern Arizona at the present time are virtually free of extensive air pollution. Studies in the Grand Canyon

and the Lake Powell Region report average visibilities of up to 200 km or 124 miles.

A study made at the Lowell Observatory in Flagstaff over a residential section indicates a visibility in the neighborhood of 55 km or 80 miles. This is considered by many as a very satisfactory degree of atmospheric condition.

Aesthetic values and air pollution in scenic forest areas which may be classified as nonurban areas have been under investigation by Northern Arizona University for the past two years. A simple and inexpensive method of ion detection of air pollution build-up is being explored. Similarity of light scattering process to the process of ion attachment on air-borne scatterers is the basis of this examination. The process is under the assumption that particle concentration and size are the main factors influencing visibility and ion-density fluctuations in the lower atmosphere. Investigations of this process are still being made but it is hoped that in the near future a simplified nonurban pollution build-up detector based on the above principal can be designed and utilized.

Pictures of the small ion counters given as Photos 3, 4, and 5 will appear at the end of this paper. Additional information pertaining to these counters will be available from the Forest Service early in 1975.

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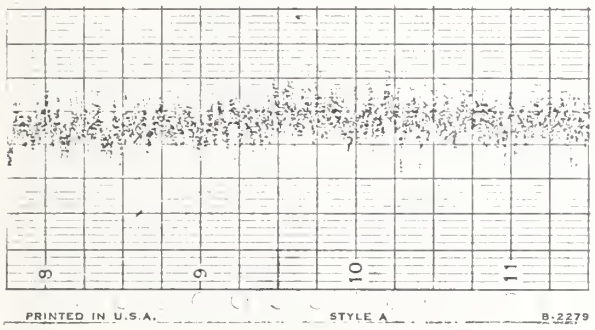
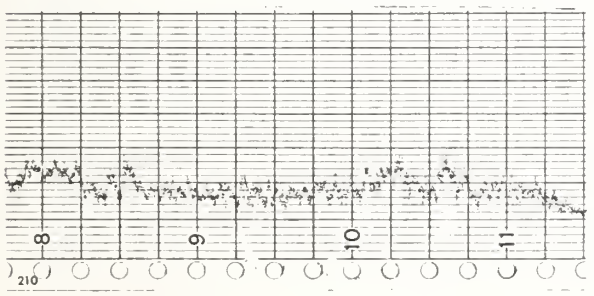


Figure 1.

Figures 1 and 2 are recordings of the ion counter which show the effect of conifer pollution - terpenes. Taken over the same interval of time, Figure 2 is 100 feet from any conifer tree.

Figure 2.



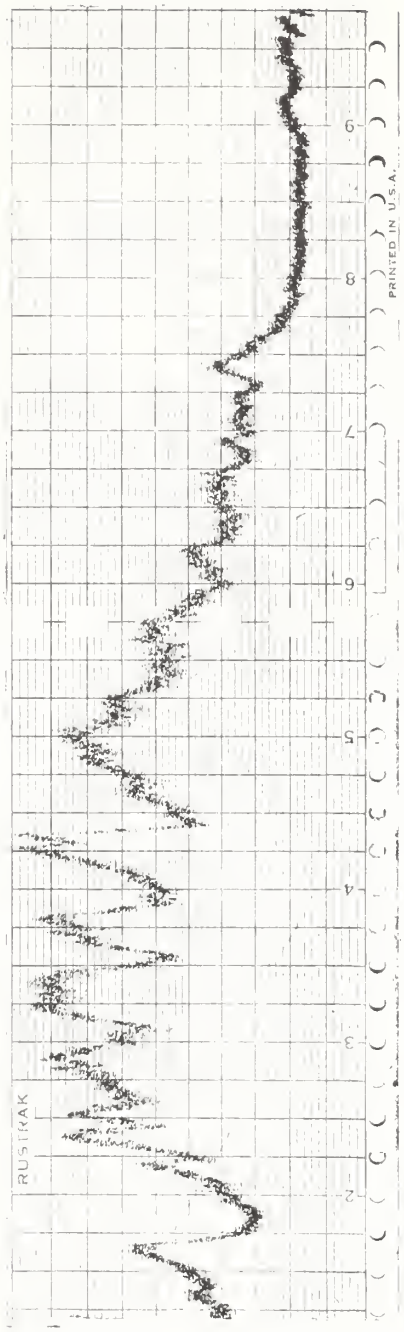
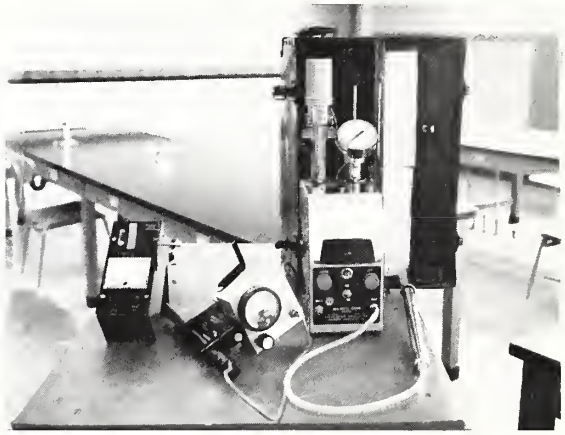


Figure 3. This figure gives a recording from the ion counter which indicates automobile pollution near a heavily-traveled highway junction in Flagstaff.

Photo 3 - Remote Counter

Photo 4 - Breakdown of Counter and Case

Photo 5 - Turbidity meter, Gaertner Particle Counter and Visibility Indicator



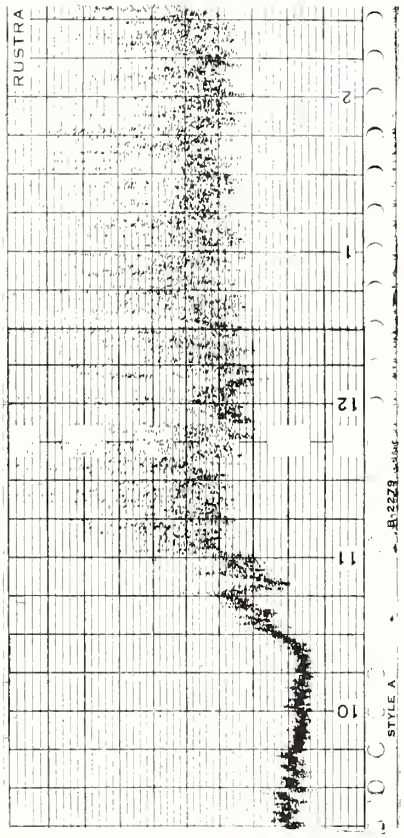


Figure 4. This Figure indicates the appearance of dust with some breeze on rural unpaved roads. Note the difference in pattern between Figures 3 and 4.

Impact of Concentrated Recreational Development on Air Quality[1]

Douglas G. Fox[2/]

Abstract.--Air quality considerations necessary to evaluate the environmental impact of mountain and wildland development are presented. A procedure is suggested which provides an orderly quantification of air pollutants emitted from concentrated recreation facilities and identification of the effects of such pollution. Our program utilizes existing data sources and modeling techniques to provide a preliminary assessment capability, a "red flag" analysis. Determination of specific impact, however, requires onsite measurements. Finally, we suggest that air quality maintenance plans be drawn and approved on a regional basis and that the plans include continued monitoring to insure the preservation of a quality environment.

INTRODUCTION

People are attracted in steadily increasing numbers to our National Forests and Parks. They seek recreational experiences ranging from wilderness camping, fishing, and picnicking to cross-country and downhill skiing, and snowmobiling. Each of these activities has some impact on the land and its use. Indeed, one could consider each particular use and describe in detail precisely how it might affect the forest system.

A common thread responsible for the lion's share of all the total impact, however, is the presence of the people themselves. People bring with them, if allowed, fossil fuels to be burned for heating and cooking, and for transportation. These are the two major categories which lead to air pollution and its resulting effects. Ironically, the very values of scenic beauty and pristine air and water which are the attraction in the first place are those in most danger of being degraded. Thus, it becomes important to "protect us from ourselves" and to develop public land management guidelines which allow the maximum usage at the minimum environmental cost. Because, concentrated developments tend to concentrate people impacts, they deserve special consideration.

It is not our purpose to define how many miles of road should be constructed in a given area, or how many dwelling units can have fireplaces. These decisions must be made by the people who own the land--the public--through the multitude of mechanisms established for this purpose. Rather, we seek to develop tools which will have the capability of providing unambiguous numbers and of organizing existing data into formats so that the public is presented with a clear picture of the environmental cost of development. To this end, we suggest here a procedure for developing the air quality part of an environmental impact statement.

A proposal for a new facility begins the process. The general design concept and initial site are identified. This information is fed into our procedure outlined in figure 1. Our first step is a calculation (Preliminary Assessment Capability) to red flag areas for potential concern. This is done by using data of an inventory nature along with the facility plans. Output from our preliminary assessment should go into design of an onsite measurement program and if necessary, back into the facility plan itself for iteration on the initial concept and its design and engineering. Onsite data should be fed not only through analysis and modeling, but also back into the original plan and design, and engineering. All these

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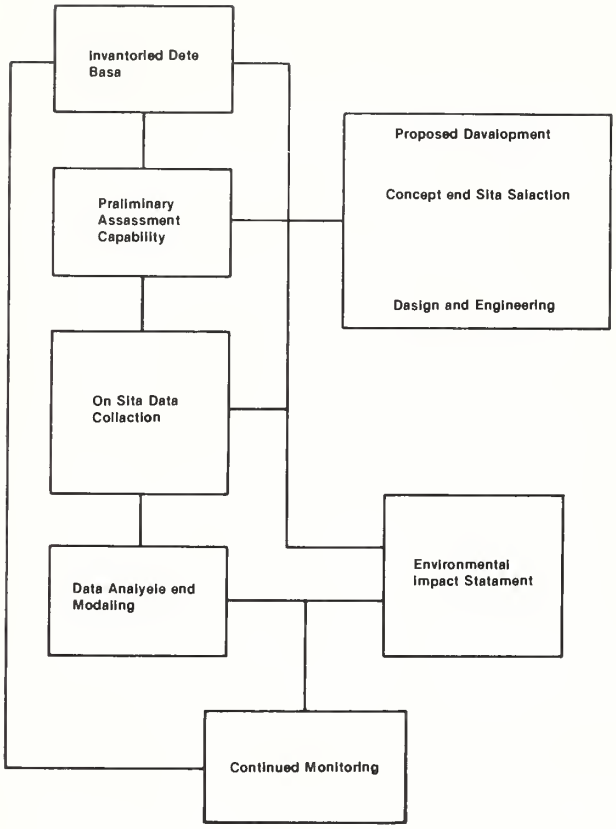

Figure 1.--A recommended procedural format for air quality impact evaluation. A development proposal (upper right) calls upon an inventoried data base for topography, climate and current air quality information. This in turn provides input for an initial assessment which in turn defines and specifies on site data needs. Modeling extends the results of data collection and provides the input for an EIS. Equally important is a need to monitor air pollution to insure maintenance of a quality environment and to provide improved information for the inventories data base.

components feed directly into the EIS, and into a regional AQMP (Air Quality Maintenance Plan) with the requirement for a continuing monitoring program. Data from the monitoring program in turn becomes a part of the future data base to improve the preliminary assessment capability of future developments. More significantly, continued monitoring immediately identifies degradation beyond an acceptable level of air quality and thereby provides a means for mitigating it.

AIR POLLUTION EMISSIONS FROM RECREATION FACILITIES

Increasing development of recreational facilities on forest and wildlands seems inevitable in view of the demands of our population for outdoor recreational experiences. Concentrated developments ranging from a simple picnic ground to a major year-round resort can produce considerable impacts on air quality. Fortunately, this concentration allows the expenditure of more money and effort on mitigation of the impacts. Thus, if properly designed, such concentrated development may generate less overall negative impact than heavily used dispersed recreation facilities.

To analyze air quality, we must first consider which pollutants may potentially be emitted, and in what amounts. Federal standards for ambient air quality have been set at levels which insure that neither health (primary standards) nor welfare (secondary standards) are impaired. Table 1 shows the Federal and Colorado State standards.

The two pollutants which have received greatest attention in Colorado are carbon monoxide (CO) and total suspended particulates (TSP). Carbon monoxide is emitted mainly from automobiles, and as such it is a consequence of our internal-combustion-oriented transportation system. The amount of CO emitted from automobiles depends on the operation cycle, the maintenance of the engine, and the load on the engine. Because motors operating at higher altitude have less oxygen available, combustion is less efficient, which results in a relatively greater emission of CO. Estimates of the mountain air quality control regions of Colorado, for example, indicate that approximatley 67 percent by weight of all air pollutants emitted is CO. In the State at large, the total emission of CO, according to the USEPA (1974), is 928,000 tons per year, of which 898,000 or 93 percent is from transportation sources. These emissions are about the same for other Rocky Mountain states. CO is also emitted from area source combustion, primarily space heating with wood, coal, oil, or gas. Rarely does this emission amount to more than 10 to 20 percent of the mobile source emission, and that much only when substantial amounts of wood are burned. However, area sources must be considered because of the timing of maximum emission with poor meteorological dispersion conditions. Nevertheless, consideration of the air quality impact of a concentrated recreational development is largely based on the number of automobiles the development will attract.

The particulate emission problem is more complex, but fortunately it is not nearly so critical a problem. The Federal standard for

Table 1.--Federal and State Air Quality Standards

Pollutant	Type of Standard	Time Interval	Compliance Date	Concentration $\mu g/m^3$	Concentration ppm
Carbon Monoxide	Federal				
	Primary & Secondary	1 hour	1977	40,000	35
		8 hour	1977	10,000	9
Hydrocarbons	Federal				
	Primary & Secondary	3 hour (6-9 a.m. only)	(see ozone)	160	0.24
Nitrogen dioxide	Federal Primary & Secondary	1 year (arith.)	(undetermined)	100	0.05
Ozone (Oxidants)	Federal Primary & Secondary	1 hour	1977	160	0.08
Sulfur dioxide	Federal				
	Primary	24 hour	1975	365	0.14
		1 yr. (arith.)	1975	80	0.03
	Secondary	3 hour	1975	1,300	0.5
	State*				
	Non-Designated areas	24 hours	1970	15	0.005
	Designated	1 hour	1973	800	0.28
			1976	300	0.10
		24 hour	1973	300	0.10
			1976	150	0.05
			1980	55	0.02
		1 yr. (arith.)	1973	60	0.02
			1976	25	0.009
			1980	10	0.004
Particulates	Federal				
	Primary	24 hour	1975	260	---
		1 yr. (geo.)	1975	75	---
	Secondary	24 hour	1975	150	---
		1 yr. (geo.)	1975	60	---
	State*				
	Non-Designated areas	24 hour	1970	150	---
		1 yr. (arith.)	1970	45	---
	Designated	24 hour	1973	200	---
			1976	180	---
			1980	150	---
		1 yr. (arith.)	1973	70	---
			1976	55	---
			1980	45	---

*State standards are currently subject to State APCD hearings and may change.

total suspended particulates (TSP) is perhaps the least defensible of all EPA standards. While health and welfare are affected adversely by suspended particulates, it is becoming clear that only some chemical compositions and some physical size ranges are critical. Compounding this problem are two factors: (1) there is a very large, poorly understood, natural particulate mass present in our atmosphere, and (2) these atmospheric particulates result from both direct emissions (fly ash, roadway dust, volcanic activity) and secondary emissions (generated in place by atmospheric chemical reactions). Recreational developments contribute primary particulate pollution heavily during construction phases. Particulates emitted from nonpaved roads are dependent upon traffic volume. However the major source of primary particulates is most likely space heating, particularly fireplaces, associated with winter recreational developments. Automobile engines also add significant amounts of primary particulates. Their importance is compounded by the fact that they are in the very small size range considered to be most detrimental to health.

Secondary particulates create a much more complex situation, and in many ways may prove to be much more significant. Secondary particulates are generated by a number of chemical reactions which occur in both "clean" and polluted air. Perhaps the most familiar of these reactions are those associated with the generation of photochemical smog in such cities as Los Angeles and Denver. Although the details are very complex, atmospheric reactions between hydrocarbons and nitrogen oxides and ozone are responsible for smog as well as for natural phenomena such as the haze over the Great Smokey Mountains in Virginia and North Carolina.

The compound identified as most damaging to people and plants in smog is ozone (O_3), produced as a result of an imbalance in the NO_2-NO-RHC equilibrium. While there are federal standards for oxidant (O_X) and hydrocarbon (H_C) levels, within Colorado only the Denver metropolitan area has been considered to have an oxidant pollution problem. Oxidants are regularly monitored and occasionally exceed standards in Denver (Colorado State Air Pollution Control Program, 1974).

An analysis of oxidant pollution in mountainous Colorado is really much beyond the scope of this paper. We wish to point out, however, that the increase in elevation and the associated increased solar radiation and decreased atmospheric density may have pronounced effects on the photochemical reactions. While the emission of reactive hydrocarbons from automobiles may not be sufficient to trigger substantial smog formation in mountainous areas, their addition to the emission of natural reactive hydrocarbons from trees and shrubs may prove more than sufficient to trip the reaction chain (Maugh 1975). Clearly, this is an area of potential impact which must receive more attention. In Pennsylvania and California, measurements of ozone have indicated high values in remote mountain locations, raising questions as to whether they were transported to the location from populated areas or were generated at the site.

A second class of reactions generates significant particulate. They involve the oxidation of sulfur dioxide (SO_2) in the atmosphere. Again, the chemistry is extremely complex and poorly understood. There are, however, two postulated mechanisms which are somewhat distinct. One involves oxidation of any SO_2 present by involvement with NO_X and O_2 and reactive hydrocarbons, ultimately yielding H_2SO_4, sulfuric acid. A second involves catalytic reactions on the surface of fine particulates, especially heavy metals, resulting in the formation of SO_4^{--} (sulfate ion) at very long distances from the sources. These reactions are likely responsible for an increasing acidity in precipitation in certain parts of the world (Dochinger and Seliga 1975). Remote mountain streams in Norway have a pH so low that they can no longer support any life. Thus, although the developments we are discussing are not large emitters of SO_2, they might suffer some secondary effects if SO_2 levels of emission are allowed to increase.

The usual procedure for calculating emissions from any source starts with an emission factor. U. S. Environmental Protection Agency emission factors for light-duty vehicles are given in Table 2. To determine the total mobile source emission from a proposed development, it is necessary to have data on both the number of automobiles anticipated and the average distance driven. An expression such as:

$$E_{co} = f_{co} \times N \times L$$

where f_{co} is the emission factor, N is number of vehicles, and L is the average distance driven, yields the desired result. One can, if necessary, be somewhat more specific by breaking out appropriate emission factors for light-duty vehicles, heavy-duty vehicles, trains, motorcycles, and aircraft. The emission factor also depends upon the vehicle age mix, since the emissions from automobiles have been decreasing year by year.

Another element is the need to adjust the emission factor upward in high altitudes. The Colorado Department of Health suggests a

Table 2.--Generalized Vehicular Emission Rates

(grams/mile)

Pollutant	Traffic Pattern	1975	1980	1985	1990 & Later
CO	Urban	60	36.5	25.0	23.8
	Other	35	14.2	9.8	9.3
HC	Urban	7.66	4.0	2.7	2.5
	Other	5.66	2.0	1.3	1.2
NO_X	Urban	4.9	2.8	1.8	1.6
	Other	-	4.2	2.7	2.4

Emission rates pertain to the following vehicular mix:

- 90% Automobiles and light-duty vehicles
- 10% Heavy-duty Trucks
- Current National Vehicular Age Distribution, pre-1960 and 1960 through 1973.

correction factor of 2 for an 8,000 foot elevation, (personal communication, Warner Resser, Colorado State Dept. of Health, 1974).

Calculating the emission from space heating fuels is easier and more precise. Emission factors exist for grams of pollutant per unit volume of fuel burned. Thus, one need only estimate fuel usage and apply the factors shown in table 3. One unknown, however, is the emission factor for wood burned in fireplaces. The approach we have used is to average the emission factors for wood in various other combustion situations. These numbers range from a low of 2 pounds of CO produced per ton of wood for an optimumly designed boiler to 140 pounds per ton for open burning. Most likely an emission factor of 100 pounds of CO per ton is not far from correct for fireplace combustion. Wood is typically burned at a rate of about 10 pounds per fireplace hour.

The final step is to estimate the total fireplace hours. By a process similar to the one for CO one can arrive at an emission factor for release of particulate material from wood combustion. A figure which seems reasonable is 17 pounds of particulate per ton.

In summary, the impact of concentrated recreational development is largely due to CO emitted from automobiles. Minor additions of CO due to wood combustion may also be a factor. Suspended particulate matter from both space heating and mobile sources is the other identified impact. One should not ignore, however, more subtle impacts which may result from photochemical reaction between auto emissions and hydrocarbons emitted from vegetation. The quality of the air also depends upon any generated pollutants mixing with low levels of pollution transported from industrialized regions.

Table 3.--Emission Factors For Space Heating

	OIL		LPG		NATURAL GAS	
	$lb/10^3$ gal.	$kg/10^3$ liters	$lb/10^3$ gal.	$kg/10^3$ liters	$lb/10^6$ $ft.^3$	$kg/10^6$ m^3
Particulates	10	12	1.8	0.22	19	302
Sulfur-oxides	144	17.25	0.09	0.01	0.6	9.6
Carbon monoxide	5	.6	1.9	0.23	20	320
Hydrocarbons	3	.35	0.7	0.084	8	128
Nitrogen oxides	12	1.5	(7 to 11)	(0.8 to 1.3)	(80 to 120)	(1280 to 1920)

Source: United States Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, Office of Air Programs, Publication No. AP-42, February 1972; Revised, April 1973.

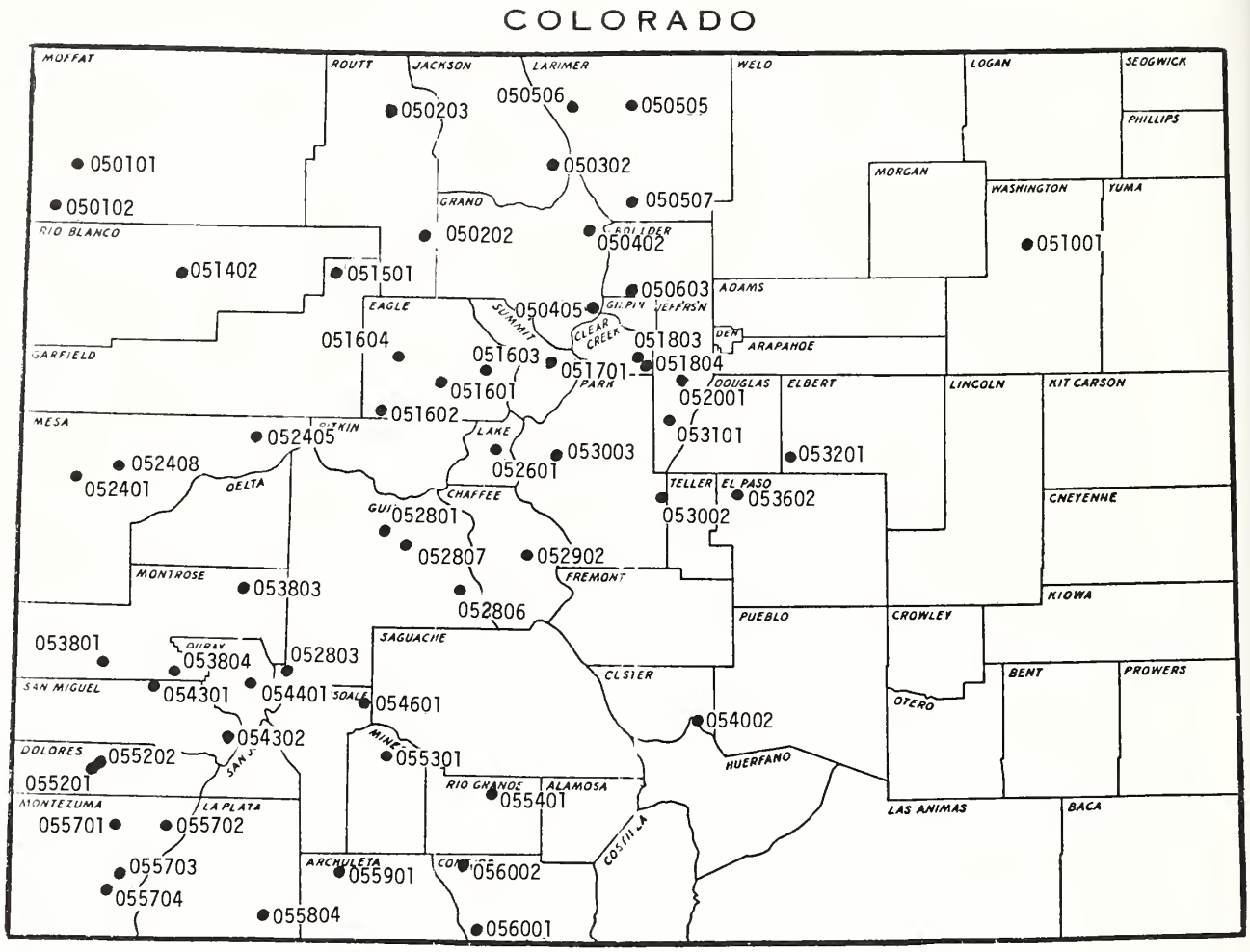

Figure 2.--Location of National Fire Weather Stations in the State of Colorado. The numbered dots locate the stations. These stations report daily temperature, humidity, precipitation, wind speed and wind direction data as well as forest fuel moisture content data. Information is organized, edited, and filed automatically, and is available from the USDA Computer Center in Fort Collins, CO.

PRELIMINARY ASSESSMENT CAPABILITY

There is a pressing need to develop quick and easy methods to identify potential air pollution problem areas. The first step in such a determination should be based upon an intelligent use of any available information. Local meteorology and climatology can be roughly determined from historical weather records. These determinations, in combination with local terrain and surface features, are often sufficient to suggest the existence or nonexistence of a potential problem. Consideration of any local data on air quality completes the rough determination of potential problem areas.

This type of procedure is only as good as the data base it uses. Two difficulties arise when attempting to apply such a procedure to mountain lands. First, the data base for meteorology in mountains is quite limited, and available data on air quality are virtually nonexistent. Secondly, the term "local" by which we qualified all the data needs has a special meaning in complex terrain. Local is defined in our application as meaning homogeneous. It is assumed that data are applicable over an area of influence. This area is then homogeneous with regard to the data in question. "Local" for a temperature measurement in eastern Colorado might be 100 square miles, while in mountains it more likely would not be greater than 1 square mile.

The extreme heterogeneity of mountain

climate is a major concern of our research group. We are actively pursuing the development of techniques to provide quantitative information about mountain meteorology and air quality. Among the research products we are developing is the wind field model used by Dr. Marlatt in his development of air pollution potential maps. This model extends the usefulness of available terrain data. Other work is based on applying sophisticated statistical techniques to determine the predictability of surface temperature and other components of climate. One development of particular significance is our recent completion of a National Fire Weather Library. This library is a computerized data inventory maintained in the USDA Fort Collins Computer Center. Information from all fire weather stations (temperature, wind, precipitation) is fed daily into the system. Figure 2 shows the location of our data sources in Colorado. Various access techniques have recently been developed to allow an interested user to obtain different kinds of information. There are two limitations which should be stated: the data are generally collected only during local fire seasons, and access to the USDA computer is necessary in order to use the system.

Three aspects of any air pollution analysis are the emission of pollutants, the volume of air into which the emission mixes and is dispersed, and the background concentration in the available volume of air. A preliminary assessment of the first and third of these factors is fairly straightforward. The emissions can be quickly calculated from the development plans and from emission factors such as those outlined in the previous section. Ambient air quality generally is excellent in areas of concern for recreational development. However, this assumption is obviously not valid for an expansion of existing facilities. In these cases, it is necessary to have data available from an ongoing monitoring system. Such a data requirement constitutes a major recommendation of this paper and is discussed in detail later.

Perhaps the most difficult component of an assessment is the estimation of the availability of air itself. Many factors enter into a determination of the volume of air with which pollutants mix. Mountains and valleys strongly affect the local wind pattern. To determine the degree of effect, one must first consider the local topography. Elevations can be readily obtained from USGS topographic maps. While a most significant mountain topographic feature is slope, the presence of a strong slope is not a sufficient condition for severe air pollution potential. The narrowness of mountain valleys and the presence or absence of openings are of greater importance.

The identification of separate drainages has been essential to the development of scientific watershed analysis. Early attempts to define air sheds for air pollution studies, however, met with very limited success. The atmosphere is much too dynamic to allow definition of an air shed, since air is generally not constrained to follow the surface like water runoff. In mountains, however, air sheds can be roughly defined around watersheds, and the concept is often useful. For a preliminary appraisal, particularly, it is appropriate to consider that the available air is limited to that in the immediate vicinity of the proposed sources, namely the particular drainage in which they are located.

Consider a proposal for a facility to be located at point A on the map of figure 3. While the development is at location A, all the automobiles entering and leaving its parking lot at A must pass point B. A proper analysis, especially in the preliminary phase, must consider all the "secondary" drainages which will be affected. The area of interest for this case would include all of the transects (1, 1), (1, 3), (3, 3) and (2, 2). A conservative limit on available air volume can be estimated by assuming a nonpermeable

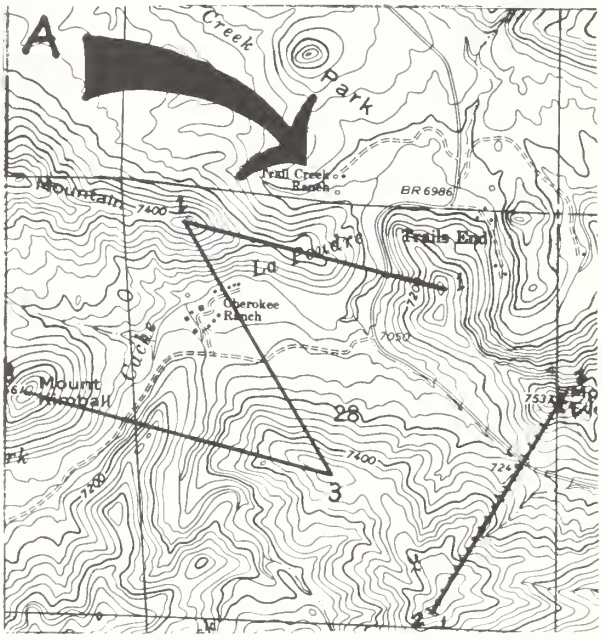

Figure 3.--Topography map locating a hypothetical development. Secondary impacts caused by automobiles attracted to the facility located at A, must be assessed in the narrow valleys leading to A. Cross sections at (1, 1) (1, 3), (3, 3) and (2, 2), are analyzed according to methods described in the paper.

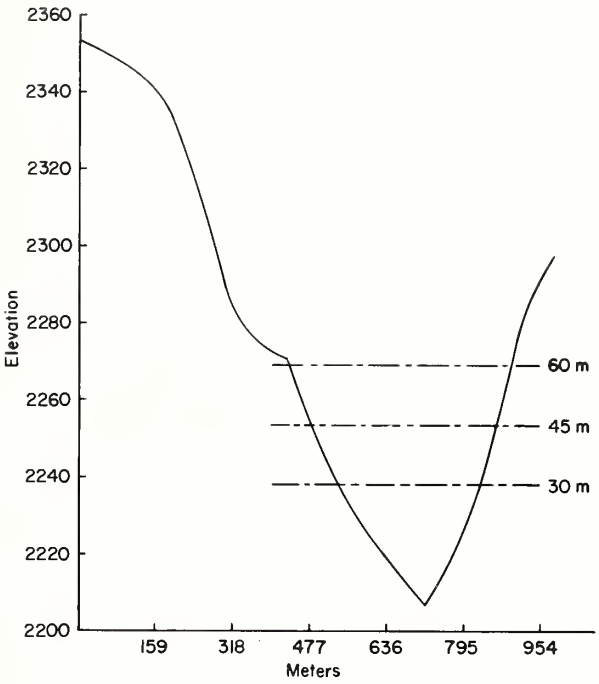

Figure 4.--Valley cross section. Plot of topography along line (2, 2) in figure 3. The triangular cross section results with a strongly varying valley column when different lids (mixing or inversion height) are assumed (dash dotted lines at 30m, 45m, and 60m). Assuming the cross section can be approximated by a triangle with a vertex angle of 55^{o}, the area is given by $A=h^2T(27.50) = .52h^2$. Respectively for h=30 45 and 60 m the cross sectioned area is $469m^2$, $1{,}054m^2$, and $1874m^2$, illustrating that a factor of 2 change in mixing depth leads to a factor of 4 change in mixing volume.

horizontal lid placed over the valley at various depths, the mixing depth or inversion depth. Figure 4 illustrates an actual valley cross section. If we assume that the concentration of pollutants, χ is given by uniformly mixing the emission, Q_o, into the available volume, V, then:

$$\chi = Q_o/V = Q_o/AL$$

where A is the average cross sectional area over the length L of the valley. Since the area A is a function of the location of the lid height, h, a graph of this height plotted against the area can be useful. From the equation above, we obtain:

$$1/A = (\chi/Q_o)L$$

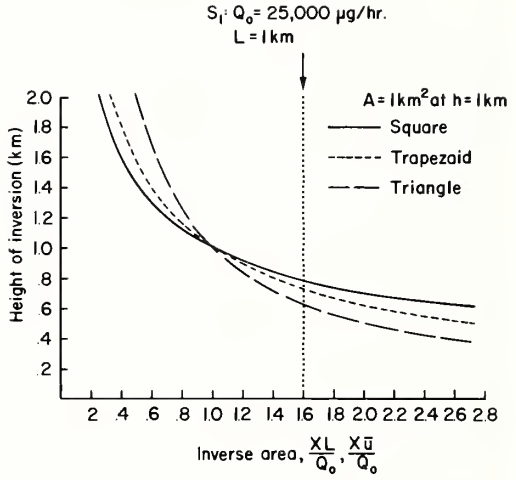

Figure 5.--Graphical estimates of limiting mixing depth. Using actual valley cross sections, such as shown in figure 4, a plot of the inverse of valley area (1/A), against the mixing height (h) can be produced. This figure uses three idealized valley cross sections, namely a triangle, a rectangle, and a trapezoid, each of which is assumed to have a 1 km^2 area when the mixing depth is 1 km. The horizontal axis becomes concentration per unit emission times either valley length or mean wind speed as explained in the text. Use of the graph is illustrated for an emission of 25.000 µg CO/m^3, and a valley length of 1 km. The 1 hr. standard (40,000 µg/m^3) for ambient concentration produces the vertical dotted line; all areas left of the line are larger so that concentration is below the standard. All areas right of the line are smaller so that concentration would exceed the standard. Quickly, one can see that should mixing depths below about 600 m occur, the standards would be exceeded. Thus minimum mixing depths for satisfying the standards can be determined from the graph.

Figure 5 is a plot of some idealized cross sectional geometrics (triangle, square, and trapezoid) against mixing height. Such a figure can be produced for actual terrain using a graph like figure 4. Because of the equation above, the horizontal axis is essentially concentration per unit emission times valley length. Its use is illustrated in the following steps:

1. Calculate the emission, Q_o.

2. Consider the limiting values of volume for the pollutant in question. For example, for CO the standards are:

H8 - 8 hour limit = 10,000 $\mu g/m^3$

H1 - 1 hour limit = 40,000 $\mu g/m^3$

3. Use an adaptation of figure 5 for the specific geometry in question to determine the mixing depth below which standards will be violated.

An analysis, such as we have outlined, provides an indication of what the minimum mixing depth can be to satisfy ambient air quality standards. The height of this mixing depth can quickly identify a potential problem when compared with a climatological analysis of mean and extreme mixing depths in the area in question.

Documented mixing depths in Colorado are as low as 150 feet (Holzworth 1969), and it is likely that even lower mixing depth may occur frequently in cold mountain valley configurations. Such extreme conditions might last only a few hours, however. The concept of an impermeable lid across a valley is, while somewhat simplistic, a valid interpretation of how the atmosphere behaves. That such lids exist is evidenced by figure 6 which shows a valley enclosed in its own pollution.

The actual mixing depth can only be determined with meteorological instruments capable of measuring the temperature structure as a function of height above ground, or with some other vertical "sounding" device. Roughly, the mixing depth is determined by the height of the lowest inversion, that is, the point at which a layer of very stable air overrides a layer of neutral or unstable air. Low inversions in mountain valleys are caused by rapid cooling of the earth's surface at nightfall. The air in contact with the ground cools, establishing a layer of stable air near the surface. As time passes, the entire stable layer rises above the ground. Pollutants are dispersed relatively slowly in such a layer, and it is nearly impossible to punch material through the inversion itself. Thus pollutants are trapped in the valley, and the analysis method described here is appropriate although conservative.

The above analysis is conservative because the atmosphere is rarely if ever at rest. Wind must be taken into account. Particularly in mountains, wind direction may change rather dramatically. The most obvious and classical of these changes are the upslope, downslope, and mountain valley winds shown in figure 7. Figure 8 shows the wind measured at a station in a mountain valley. The wind clearly displays a classical pattern. The air pollution potential maps shown and discussed by Professor Marlatt were developed to provide

Figure 6.--Photograph of a ground based inversion (low mixing depth) in a mountain valley.

an estimate of the speed and direction of winds which blow in the mountains. While these maps were not designed to give specific information, the relative information they provide can be extremely valuable. If an area is in a high pollution potential zone, and also has a low mixing depth limit, it clearly has a potential air quality problem. On the other hand, a region located in a low air pollution potential zone should be analyzed with a different valley volume model.

Since the pollution potential map is based upon wind deflections, a low air pollution potential indicates that the wind is usually blowing fairly well. For such cases, a modified box model can be derived to allow the inclusion of a wind velocity. The resulting equation is:

$$\chi = Q_o / \bar{u} A$$

where $\bar{u}$ is the average wind through the average cross sectional area, A. This analysis can be applied to figure 4. If we estimate the mixing depth, the value of $\frac{\chi \bar{u}}{Q_o}$ may be determined on the horizontal axis of a figure such as figure 5, but for a specific valley. With knowledge of the mean wind speed, we can estimate the ambient concentration.

Use of the techniques we have described can lead to a rapid indication of the likely air quality degradation associated with a proposed development. It would seem that such procedures would be of greatest use when closely tied to site selection and initial planning of any development.

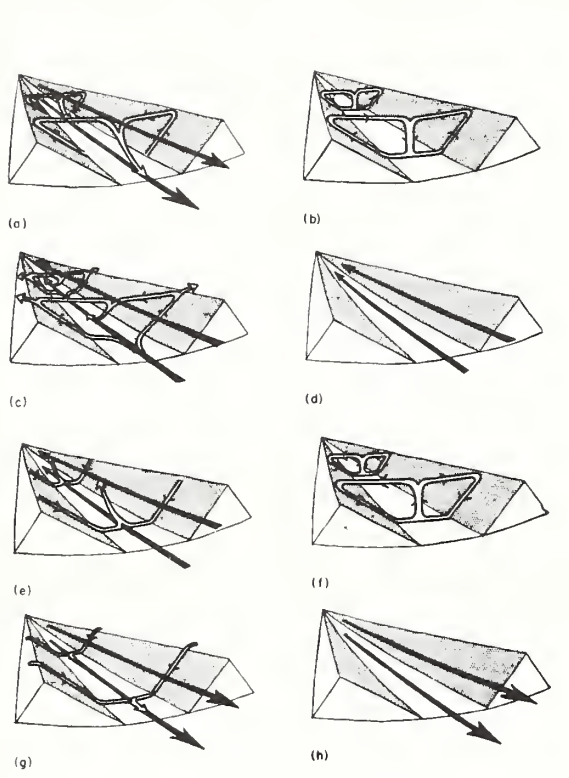

Figure 7.--Schematic illustration of the normal diurnal variations of the air currents in a valley (after F. Defant):

a. Sunrise; onset of upslope winds (white arrows), continuation of mountain wind (black arrows). Valley cold, plains warm.
b. Forenoon (about 0900); strong slope winds, transition from mountain wind to valley wind. Valley temperature same as plains.
c. Noon and early afternoon; diminishing slope winds, fully developed valley wind. Valley warmer than plains.
d. Late afternoon; slope winds have ceased, valley wind continues. Valley continues warmer than plains.
e. Evening; onset of downslope winds, diminishing valley wind. Valley only slightly warmer than plains.
f. Early night; well-developed downslope winds, transition from valley wind to mountain wind. Valley and plains at same temperature.
g. Middle of night; downslope winds continue, mountain wind fully developed. Valley colder than plains.
h. Late night to morning; downslope winds have ceased, mountain wind fills valley. Valley colder than plains.

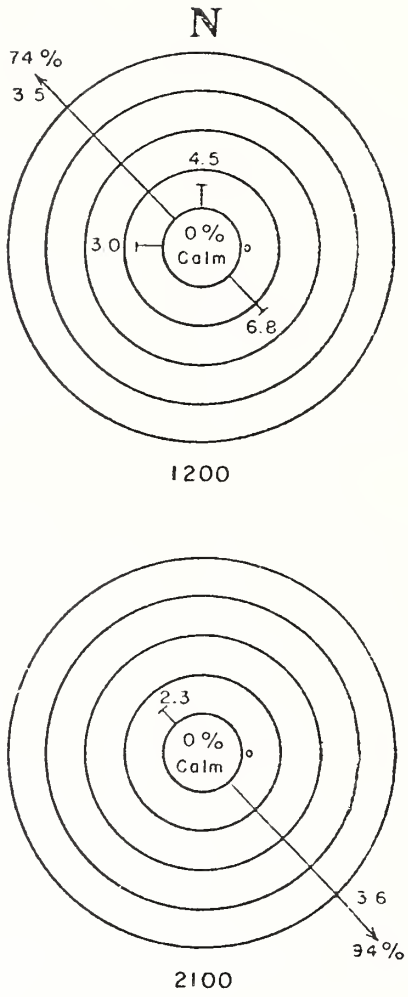

Figure 8. Measured surface winds in a mountain valley. Time average for a month illustrates that the flow is upslope at noon 74% of the time with an average speed of 3.5 mps, and is downslope 94% of the time with an average speed of 3.6 mps at 9:00 pm.

ON-SITE DATA COLLECTION

On-site data collection is necessary in most instances where an actual environmental impact statement must be filed. A preliminary assessment is helpful to indicate potential areas of pollution and to define the extent of any likely problems. On-site data collection therefore, should be designed around the results of a preliminary assessment.

The nature of on-site data collection precludes the development of a general routine. Rather, each situation must be studied. It is possible, however, to define the principal elements of a meteorological and climatological study. The nature of the atmosphere is such that it varies tremendously from day to day, but also exhibits rather stable mean values over time. The climatology of an area, represented by these means, can be a most useful set of information. Such climatology in mountainous conditions, unfortunately, is very specific to the measuring stations. It is as useless for our purposes to say that Colorado has an average snowfall of x inches as it is to say that Vail has an average snowfall of z inches, because in both cases that average is composed of a widely varying signal. Much more significant is a qualification of the average in terms of known variables of significance. For example, Colorado above 10,000 ft, has an average snowfall of y inches is a much more useful concept. Development of such a local climatology requires a number of measurement stations operating for a period of time. It is well to recall that the air quality standards are set on the basis of annual averages not to be exceeded, and shorter term (24-hour, 8 hour, 3 hours, 2 hour, and 1 hour) averages not to be exceeded more than once in a 1-year period. One must collect data for at least 1 year to determine the worst meteorological intervals during that time. Even then, because of the vast complexity of atmospheric behavior, it is impossible to determine whether your year of data is typical.

Clearly, the first question of on-site collection is how long must one collect the the data. "As long as possible" is an unrealistic (though safe) answer because of the expense of both collection and analysis. Data collection during only a single season is justifiable only if the development under consideration will emit pollutants during only that season. Thus, if available funds are limited, it makes most sense to design a data collection scheme which provides some information throughout the year. Three days of data each month are, for most impact assessment considerations, more useful than a single month of continuous data.

One further point regarding time involves the daily variations of our atmosphere. Particularly in continental climates the variations throughout the day are very large; often more significant than day-to-day variation. It is necessary, therefore, to collect data throughout a few 24-hour periods to resolve these diurnal variations.

What needs to be measured and where? Such a question and the fact that it is unanswerable

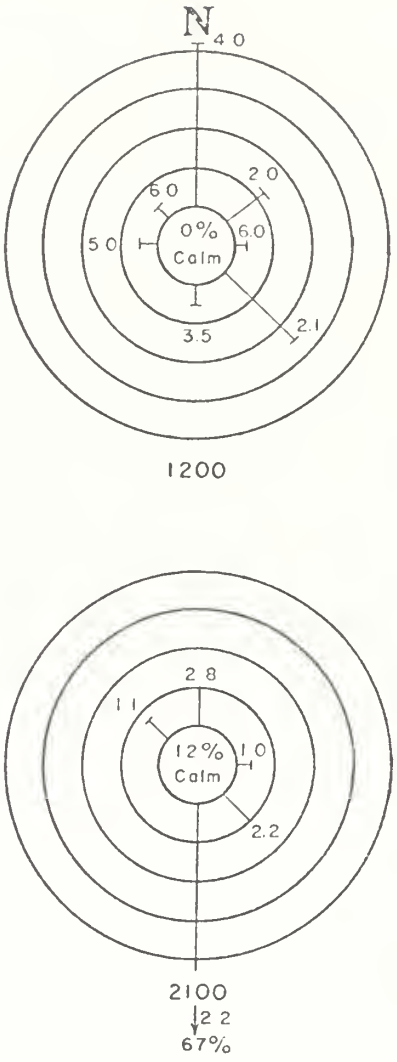

Figure 9.--Measured surface winds about one mile away from those of figure 8. This station responds more to the wind field aloft than does the earlier one. Nevertheless, the downslope flow is quite effective in establishing itself 67% of the time.

in general reflects our lack of knowledge about mountain meteorology. Figure 9 is a record of a wind measured approximately one mile (up a steep slope, basically on a mountain top) away from the measurements in figure 8. The fact that these two are so dissimilar illustrates how small the aforementioned area of influence can be. Stations, in order to have any meaning at all, must be very carefully located. Particularly important are the immediate surroundings of the measurement, such as presence or absence of forest and the characteristics of the forest. Other components of the land

use pattern in the station vicinity must also be considered--buildings, crops, grasslands, all exhibit their own microclimate. Spatial density of measurements required is probably most meaningfully determined by the amount of money available. Measurements should be made, however, at all locations where the preliminary analysis indicated problems. The number required at each location is dependent upon the specific site characteristics, and can only be determined by onsite investigations by competent observers.

It is somewhat easier to be specific regarding what needs to be measured. The variables of meteorology are wind speed and direction, temperature of the atmosphere, and the amount of available water vapor. Each is a three-dimensional continuously varying function. Thus at best, we are able to measure one or two points and hope they determine the functions. Since most of the pollutants we are concerned with are emitted at or near ground level, it is necessary to measure the wind speed and direction at or near ground level. Unfortunately, wind changes with height are most dramatic in mountains. Temperature is perhaps most significant as a function of height, for it is the temperature variation with height which defines the inversion. Thus, not only surface measurements but also measurements at points above the surface are necessary to complete the picture. Such measurements are often difficult and always expensive to obtain. A standard method is to release a "radiosonde" or small balloon with a trailing instrument package which sends a periodic signal back to a receiving and recording station. This gives wind information of low quality, however, and only with great effort. Recent remote techniques, such as the acoustic sounder which sends and then receives a reflected acoustic wave and other similar concepts, hold promise of eventually providing rapid and inexpensive vertical information. The use of balloon-supported instrumentation offers a cheaper, more versatile, alternative to construction of a meteorological tower. Our Project is experimenting with a number of these devices in mountain environments.

It is difficult to say much more about on-site data collection. This is really a part of the impact analysis which requires both experience and a good deal of trial and error.

DATA ANALYSIS AND MODELING

The purpose of this component of the impact assessment is to extend data collected on-site to a wider region of validity, and to couple the data with emissions to develop a model of ambient air quality levels resulting from the proposed development.

There are a number of methods generally available which allow the calculation of ambient concentration, given the source emission parameters and some meteorological information. Professor Berman, in his article in these proceedings, mentions the two generally accepted methods of calculating concentrations, namely the Gaussian Plume model and the more general air shed model. These are both based upon applying the conservation of mass to the material released from the source. The Gaussian Plume model assumes that the material is distributed according to a Gaussian curve. This specifies the spatial variation about the crosswind coordinate. The only remaining parameter is the downwind decrease in the centerline concentration, which is determined from the wind speed and atmospheric stability. The Gaussian model has been used for many years, and is particularly appropriate for situations where the source distribution is simple and the wind speed is steady and strong. These conditions allow the assumptions made in the Gaussian model to be valid. The model treats the source region as being either a point, line, or an area. Recreational facilities are approximated as area sources. Area sources are the type for which the model used by Berman is appropriate. Line sources are most appropriate when a highway segment is under study. Since there are a number of standard references for the detailed formulas we will not pursue these but refer the interested reader to the literature, (Turner 1970 and Slade, 1968).
We mentioned the use of "box" models and ventilated box models in an earlier section. One can develop such models to a high degree of sophistication. Some of the limitations of such models have been discussed in depth (Fox 1975). Nevertheless, some words of caution are appropriate.

In the mountains, wind fields respond to local forcing due to thermal differences, as we showed in figure 7. They are also influenced by physical barriers, each of which influences the flow. The major difficulty in modeling the air quality of a mountain valley reduces to determining the wind field in the required detail. An example of the complexity which may exist is shown in figure 10, illustrating that the actual flow is a combination of general flow aloft, above the terrain, and the local flow. The Mountain Meteorology project at the Rocky Mountain Station, is actively pursuing methods to simulate such complex wind fields. One early result has been the development of a model which incorporates the forcing due to the physical presence of the terrain as well as thermal influences for air near the ground. This model (Fosberg et al. 1975) which calculates alterations to a prescribed flow field, has been used for environmental assessments in mountainous terrain. Roughly, the

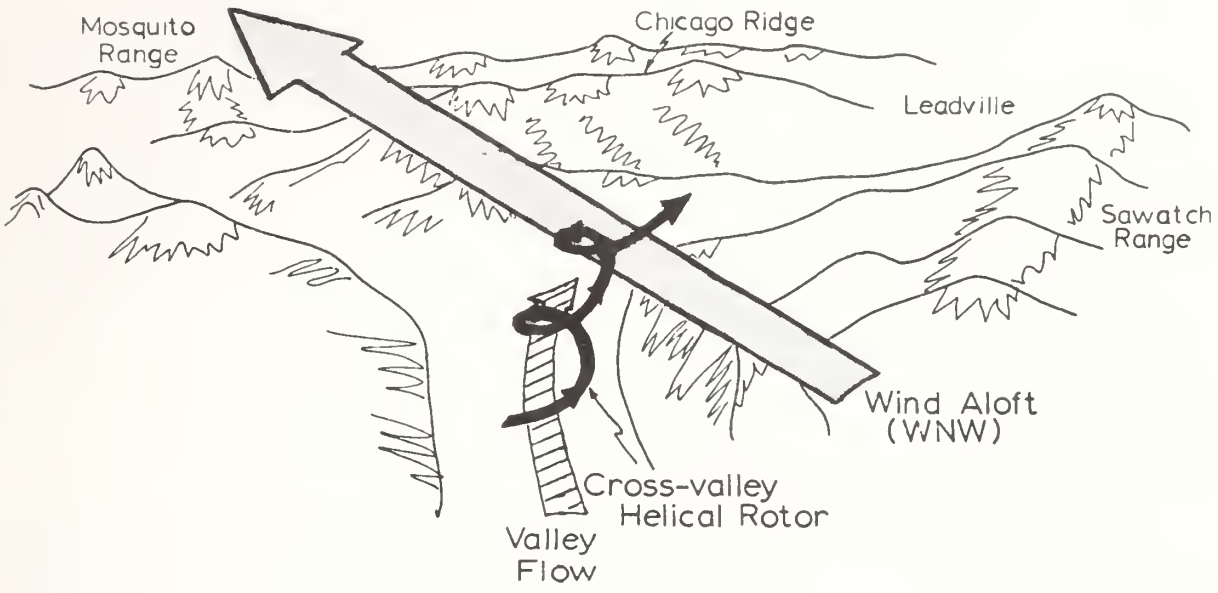

Figure 10.--Characterization of the airflow patterns within and over the Eagle River--Mitchell Creek area, looking south. The curved hatched arrow indicates the up-valley movement in the helical rotors. The stippled arrow represents the west-northwest gradient flow above the peaks and ridges (after Wooldridge and Orgill, 1975).

output from this model is valid over a range of scales up to about 200 km and down to about 2 km. At scales larger and smaller than these, assumptions made in developing the model are violated. Currently we are working on methods of incorporating a pollutant dispersion calculation into the model. Other work includes attempts to specify the precise nature of the wind distribution in the canopy (Bergen 1971). Finally, we are attempting to develop methods to delineate the magnitude of the classical flow patterns which occur (fig. 7) in mountains (Bergen 1969). Hopefully in the near future some of these techniques will be well enough developed and documented that they will be as easy to use as the Gaussian model is currently.

AIR QUALITY MAINTENANCE

The purpose of discussing and analyzing environmental impacts is to develop the tools and procedures for maintaining air quality at an acceptable level. The determination of that acceptable level, however, is not simply a scientific question but must involve economics, law, and most importantly, public participation. The levels of air quality governed by federal standards are set with a "factor of safety" below the threshold of identifiable impairment to health and welfare. As Kneese and Schultze (1975, p. 51) point out, "The notation of a threshold value can be regarded as a politically convenient fiction which permits the law to appear to require pollution damage to be reduced to zero - an absolutely unambiguous number."

Unfortunately, we have insufficient knowledge about the effects of air pollutants on terrestrial ecosystems to quantify the relationships between ambient concentration and damage. It is naive to assume that an increment of pollution has no effect until concentration rises above a set level. The problem is more complicated than that. Provisions of the Clean Air Amendments of 1970 directed that certain areas of the country be protected from significant degradation. The argument over what constitutes degradation has been waging since in the courts. EPA has suggested three classes (I, II, III) of allowable degradation. Class III is a highly polluted area where it is necessary only to satisfy the standards. Class II is an area where some development is allowed and is defined as "insignificant." Finally, Class I areas are clean and virtually no development will be acceptable. The EPA has tentatively designated all areas of the country, except those already not meeting the standards as Class II. It is up to the States to reclassify any of these areas as Class I or Class III. The advantage of a Class I designation is that pristine air quality would be guaranteed. Such non-standard considerations as visibility reduction due to particulates would be guarded

against. A classification of this sort can be valuable to a community as a means of growth control and air quality maintenance.

Regardless of the legality, the value of clean air to any outdoor-oriented recreational activity is obvious. As a means of ensuring the maintenance of existing quality, it is necessary to have a good idea at all times of precisely what that quality is. A first step in the development of an air quality maintenance plan is to determine the current air quality by the installation of monitoring equipment. With two general exceptions, there is no air quality monitoring in mountainous Colorado. The exceptions are (1) a smattering of "high-volume" samplers in various towns, and (2) intense data collection for environmental impact statements and federal lease requirements on major developments (oil shale, coal, power plants, etc.).

A general air quality maintenance plan should include monitoring of all pollutants of concern. For a recreational community, a high-volume sampler array for particulates and CO monitoring equipment would meet minimum data-gathering requirements. Meteorological conditions should be measured in conjunction with these.

The data collected from such monitoring could be stored in an inventoried data base. Among the many uses for such data, two should be mentioned. First, development within a particular community could be more meaningfully evaluated in terms of its likely air quality impact if current levels were known. It would be relatively straight forward to determine through modeling, the incremental loading due to the development, and by comparison with current air quality, determine its desirability rather meaningfully. Secondly, we can use such data as an aid in dynamic air quality maintenance.

Dynamic air quality maintenance or intermittent control, while a somewhat controversial control procedure, can be very effective in maintaining local air quality. Such a plan would be based on monitoring the air quality levels and developing forecast techniques capable of determining when the ambient concentrations are likely to reach unacceptable levels. Such forecasting can be done routinely by considering meteorological conditions (availability of local meteorological information is necessary) a forecast of these meteorological conditions and knowledge of the emissions during the forecast period. On this basis, a community might require that fireplaces not be used or that automobile usage be kept to a minimum during severe conditions.

Once a community decides what its air quality should be, and it measures its current situation, there are a few mechanisms available to help it maintain a given quality. In considering a recreational development, the two sources of most concern are automobiles and space heating, especially fireplaces. While I know of no good technology immediately available, it should be possible to devise various systems for controlling fireplace emissions. One word about economics in this situation is in order. Kneese and Schultze (1975) make a persuasive argument for taxation of emissions as an equitable and workable mechanism for pollution control. Individuals will not buy an emission control system without some strong incentive. They suggest the incentive be applied negatively so that, for example, a rather substantial and continuing tax be charged against noncontrolled fireplaces. Thus, it would be economically sensible to install an emission control system.

Certainly an obvious resource which could be utilized in mountain recreational developments, and which would effectively reduce pollution, is solar energy. Already, most ski lodges are designed to take advantage of south-facing, sunny locations. Solar heating systems have developed to the extent that they can be economically competitive with other heating systems after 5 to 10 years in private dwellings. Indeed, because of the high insolation (incoming solar radiation) of mountains, solar energy applications hold great promise.

One further concept in mountain town planning might be mentioned. Most of our intensified development has taken place at the valley base. From an air pollution viewpoint, this is probably the worst place to locate a source since its emissions will often be trapped. On the other hand, elevating the development even a small distance up the valley walls might be sufficient to eliminate many potential problems.

Automobiles appear to be the worst offenders and are most responsible for air quality degradation in the United States. The simplest method for minimizing their impact is to reduce the number of vehicle miles driven. A most effective way of doing this is through intelligent urban planning so that automobiles are not necessary, or indeed are not allowed, in valley bottom towns. Where areas encompassed are too large for walking access, mass transportation and bike paths can be successfully arranged.

For many years the European mountains have been accessible mainly by rail and other mass transport facilities. While the automobile is still too inexpensive and available to most Americans to make mass transportation a real alternative, there seems little question but that the future will see the development of increased public transportation systems. An innovative experience could be offered in

Colorado through renewed interest in the old narrow gauge railroad system. These lines served most of the old mining towns which have recently struck it rich on the tourist industry.

Finally, one concept should be mentioned in closing. This is the idea of regional maintenance plans. Duplication of data collection and detailed environmental impact studies seem pointless for similar areas. If regional groups could be established with environmental maintenance plans, the whole process might be made significantly more acceptable to all concerned.

CONCLUSIONS

Our approach to the analysis of impacts of recreational development on air quality is shown in figure 1. This procedure, and the detailed discussions of its various components, will allow a meaningful identification of problem areas, and hopefully can indicate ways to mitigate these problems.

All of the suggestions in this paper have a cost. Environmental protection, as we have learned only too well, is not free. Precisely who pays the cost and how is not at issue here. Our point is that, without spending the necessary funds to continuously evaluate environmental quality, the National Environmental Policy Act of 1969 and the Clean Air Amendments of 1970 are pointless. It is impossible to monitor air quality by simply looking at the predicted incremental effects due to a host of separate impact statements. For this reason, we feelthat our procedures can be most readily and meaningfully adopted within the context of regional air quality units. It makes more sense to apply the techniques to multi-county units with geographic, topographic, and climatologic homogeneity. Such applications could yield a "carrying capacity" for air pollutants so that each proposed development could be judged against this capacity.

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Session III Discussion

Session IIIA

William Welch, ASU: Dr. Kneese, do you think we're still facing the large-scale generation of electric power from coal that was estimated from the 1970-71 figures?

Alan Kneese: I don't think electric power generation will rise as quickly as was anticipated at that time. Two things are happening that might cause the development of coal in the region to be even much larger than was contemplated. One is the Federal Energy Administration's feeling that coal is the resource of the future. Second is that there is an enormous amount of it. Our reserves are greatly underestimated; we don't have any real conception of how much there is. Another thing is this business about increasing our self-sufficiency in petroleum. Unless something happens on the Continental Shelf and in Alaska that we don't anticipate, we will be facing a declining output of petroleum, probably within the next 15 years. If we are to continue to have an economy that is very heavily based on liquid fuel and piping things around, the only place such liquid fuel could come from domestically is coal. Inevitably, there will be a very large development of coal resources in the western U.S.

Robert Dils, CSU: Can you give any comparison between the Four Corners coal resource and the potential for the Wyoming-Dakota-western Montana area?

Welch: I think the coal resource might be larger in the Wyoming area, but because of transmission distances, electrical energy deliverable might be larger in the Four Corners. Incidentally, for various reasons, the Geological Survey has drastically reduced its estimates of off-shore oil reserves in the last six months.

Loren Potter, UNM: Is there a movement to use coal for fuel, and save petroleum for production of chemicals? Many of us don't appreciate the dependency of our chemical industry on petroleum as a raw material.

Kneese: As time passes, the price of readily available hydrocarbons in liquid and gaseous forms is going to rise strongly to the point where their manufacture from coal and maybe from shale is economical. If the most desirable raw material happens to be oil, it will go into those uses that require high-quality hydrocarbons. Price will be the determining factor, I suspect.

Dils: A number of Colorado counties are now requiring, for either second or first homes, that an aerating system be associated with septic tanks and drain fields in rural areas. How effective are these systems?

Burton Segall: I think we're still in the developmental stage right now.

Session IIIB

James Gosz, UNM: We've been talking a lot about primary emissions. Has anyone done any modeling of natural pollution decay rates--absorption by soil, by vegetation, that sort of thing?

Douglas Fox: At the Acid Precipitation meeting we had a workshop on the transport, and atmospheric chemistry and removal of pollutants. The fundamental problem is, we simply don't understand atmospheric chemistry. It's extremely complex, and we know very little about it. We do know that we get removal in two ways: dry removal and wet removal. We know something about the dry removal of SO_2. If we multiply the concentration times the deposition velocity we can account for the decay rate of gaseous SO_2. When the SO_2 reacts for 5 to 8 hours in various photochemical reactions in the atmosphere, however, we generate extremely small sulfate particulates that don't fall out very well. They're removed by precipitation. But we don't know the chemistry by which these pollutants are absorbed into the rainfall.

William Marlatt: In the West, the fact that many of our surface soils are alkaline may explain the higher apparent pH of rainfall.

Dust from these soils may collect in rain gauge funnels between rains. Then rainfall, especially a light one, which may have been somewhat acidic is at least partially neutralized. Dust in the lower atmosphere may have a similar effect.

I'd like to comment also that our models really aren't sophisticated enough as yet to handle decay. For example, the gaussian plume model starts with the assumption that wind speed stays the same in direction and velocity from the top of the smoke stack forever on down stream. We know that can't be. Our box model has been applied here in Vail. Generally, the pollution in Vail Village flows up into East Vail during the day, then turns around at night and flows back down to West Vail, and they get the accumulation. However, we don't know how long the drainage winds flow compared to the upslope winds.

Question: It has been mentioned that only carbon dioxide and particulates are being measured. Do you feel there is a need to measure parameters such as ozone, hydrocarbons, and CO in areas such as Vail?

Marlatt: It seems incongruous, but the only place in Colorado, outside of Denver, where extensive measurements are being made is in the oil-shale regions, where pollutant levels are barely at the threshhold of measurability.

Fox: The question of ozone and photochemical pollutants at high elevations is an interesting one because of the higher radiation environment. Although carbon monoxide and outside emissions from the highway are significant, if not substantial, everything we are beginning to learn about the photochemical reactions now points to the creation of ozone and photochemical pollutants in natural areas from the reactive hydrocarbons in the vegetation.

Question: Do you see any worldwide changes in the atmosphere?

Fox: Not really, on a worldwide basis; the earth's atmosphere is a pretty big thing. Levels of particulates do fluctuate widely, however, due to agricultural cycles, volcanic activity, and so forth. There are definite regional trends, however. Norway, for instance, is suffering considerable damage to forests and fish due to acidic precipitation.

SESSION IV

GROUP DISCUSSION OF IMPACTS OF DISPERSED AND CONCENTRATED RECREATION DEVELOPMENT

Chairman: Floyd C. Mann, Director
Environmental Council
University of Colorado

Coordinator: H. William Welch, Associate Dean
College of Engineering Sciences
Arizona State University

For this session, the symposium participants divided into four separate groups. Each group was charged with the development of answers to two general questions related to the research program, and one specific question related to the role of the Eisenhower Consortium. Group leaders, selected from the Symposium attendees with no Consortium or research connections, reported the recommendations of each group at the end of the session. General questions answered by all four groups were:

What research topics do you recommend for future Eisenhower Consortium activity?

Which of these research topics rank in the top five priority?

Group A Report

George W. Tourtillot, Leader

Director, Recreation and Lands
U.S. Forest Service, Region 2, Denver

Specific Question: How can the Eisenhower Consortium more effectively involve the politician, local planner, and forest manager in a researcher/user partnership?

When the President of the Consortium put this series of specific questions together, he recognized the four specific questions were related. Generally, the members of Group A agreed there are some basic problems in the vehicles or mechanisms of how research results get to the people who are going to use them. What information is available? How do I "get my hands on it?" What is this relationship of the research to my specific problem?

There are a lot of new people coming on board, such as County Planners, County Commissioners, other local and State political figures. These folks are now getting into the act that a lot of us have been involved in for some time. All of us have quite literally been flying by the seat of our pants over the years. There is a new level of professional people in the State and local governments. These people are zeroing in on many of the specific problems that we also are trying to come up with answers for.

Our group dealt with the specific question: "How can the Eisenhower Consortium more effectively involve the politicians, the local planners, and the forest managers in a researcher-user partnership?"

The first suggestion dealt with "symposium structure". In a symposium configuration it would appear that a more direct relationship between the researcher giving the paper and the people who are interested in that particular subject area could benefit greatly by a discussion right then and there on a one-to-one basis.

The second suggestion, which is tied to the first, is in essence a more informal arrangement of the symposium. We understood that this Vail Symposium was set up to serve a given purpose--to determine "where we are after three years and how can we make it better".

The third suggestion deals with local symposiums or meetings. We recognized that the Vail Symposium was quite expensive. Perhaps many people who would have benefited from the discussions were not able to attend. There is an indication that a number of people, such as County Commissioners, County Planners, State officials, etc., did not know the symposium was being held or were unaware of its purpose and benefits. Therefore, to have these "users" participate in future meetings, they might better be held on a more local basis and deal with specific research projects grouped so that "classes of users" can identify with their problems more directly.

The fourth suggestion deals with "How can we get a broader participation in future symposiums?" We constantly seem to talk to "ourselves" at these meetings. Perhaps we need the bankers and developers along with the politicians in order to have a better understanding of the problems and possible research solutions for all concerned.

The fifth suggestion deals with the amount of money available to the Consortium. The Eisenhower Consortium had to start somewhere, and it appears that over time financing will get better. There is a need to recognize greater financing capability, because we are dealing with problems involving multi-million dollar investments, epitomized by the Vails and Aspens.

The sixth suggestion deals with "How are research projects chosen?" We recognize

that National Forest Administration, National Forest Research, and the universities have a mechanism of inputs through the Consortium. Because of the interest by other government entities and our other users of the research, there is a need for a mechanism by which they can make an input into future research projects. A broader input base would give a better clue as to the projects the Consortium could fund, and the time required relative to need.

The seventh suggestion deals with the distribution of available monies. Presently, the Consortium is obligating all of the available funds to specific research projects. Because of the time requirements to do research and the speed with which questions seem to be surfacing, there appear to be alternative ways to get more for the dollar. Perhaps, then, a portion of the available funds could be withheld (put in a pot) so that a "consultant" might also be made available to a user on short notice. The "consultant" might also be made available on the front end of a problem discussion wherein he could bring to the user available knowledge along with a critique of the project at its inception.

The eighth suggestion deals with the amount of information available and the mechanisms to make this information known to any user. A lot of people are doing a lot of things, but a lot of potential users do not know what and where results-type information is available.

The ninth suggestion deals with a mechanism to take a highly technical document and make it more understandable to the user. This could be in the form of a "Readers' Digest" version in layman's language, another element of suggestion seven, wherein the individual having done the research is available to the user as a "consultant" to explain and help the user implement the research.

Many of the above suggestions are of course closely related to each other. Therefore, to answer the specific questions that Group A dealt with, the officers of the Consortium might better consider them as a single entity.

The following are Group A's suggestions for research projects:

1. Transportation Systems. This project would deal not only with roads on and into a National Forest (or any other geographical area), but could include impacts created by the Interstate System, i.e., the impacts on the Rocky Mountains from Easterners using the Interstate System.

2. Development of mechanisms to get research data and other knowledge into the hands of the user. Included in this project would be knowledge, not only of new research, that is available so that a "new user" does not have to reinvent the wheel. For example, Vermont may have resolved a given situation that a user in Arizona is faced with--the trick is to get Vermont's knowledge into the hands of the Arizona user.

3. Water quality and quantity in the Rocky Mountain Region. This element is so broad that it would need to be broken down in specific projects, i.e., criteria to evaluate stream flows from recreation and esthetic standpoints.

4. Research capabilities. This project would deal with who can best do different types of research. There is a myriad of research on-going at all levels of both governments and universities as well as private sectors. This project would then be to determine what types of research can best be handled by whom. A mechanism would also be needed to get the research done after determining who can best do it.

5. Energy. We are aware that the size of the energy "iceberg" has not been determined. We can hypothesize that as national energy policy is formulated and resolved, there will be large impacts and demands for recreation associated with new communities and their citizens in new geographical locations. It appears that, as the new communities evolve, recreation demands will also change. How predictable are these changes? Do summer homes, after a period of time, become permanent residences? As communities evolve, different classes of people are involved--are the demands of these different classes predictable?

The above are not necessarily in order of priority, but do represent a consensus of the top five research projects from the many that Group A came up with.

Group B Report

Dennis M. Thompson, Leader

Governor's Office of Planning and Development
Phoenix, Arizona

Specific Question: What could the Eisenhower Consortium do to encourage the evolution of piecemeal planning efforts into a coordinated approach?

I believe we were asking different sides of the same question as Group A. We'll try to add to their comments. We did ask the specific question, and we'll start with that: "What can the Eisenhower Consortium do to assist in the evolution of piece-meal findings into a more coordinated approach?"

There are four reasons. We raise this question, "Why?" First of all, Mr. Conklin's opening address indicated to us that it is unlikely that Congress will act within the near future to establish comprehensive land use or comprehensive resource planning legislation. Secondly, state legislatures, specifically Arizona, have recently dealt comprehensive planning legislation a blow. Arizona's last legislature defeated a bill to establish a comprehensive planning mechanism. The bill had been proposed by a commission under the direction of a former legislature, so there are continuing problems in legislation itself. The third reason is the inability of the planning profession to agree on what comprehensive planning is. Until we can agree on what comprehensive planning is and how it can be made operational, Congress and the legislators are correct in being skeptical. Fourthly, there is limited effectiveness, as we all know, in the local arena where comprehensive planning -- if it works at all--is supposed to work.

Because of these factors, it seems that we are stuck, within the near future at least, with taking our piece-meal approach to planning, taking the legislation we have on the books, with some additions, taking the methods we have, and somehow making them work. The question for the Consortium is: "Can the Consortium participate in making our planning processes, such as they are, more effective?"

The following are some of the suggestions we came up with.

It might be appropriate for the Consortium to inquire as to why our legislation has failed. Is it because of lack of understanding on what planning is, are we really that deficient in our definition? Is it because of the political process itself? Is it because of inherent flaws in legislation? In Arizona, for example, one of the big issues facing the current legislature was an inability to agree on what the "taking" clause within that law meant. What does it really mean in terms of taking private property? What does it really mean in terms of State dollars that are going to be required to compensate owners. That's a very specific and timely research topic to be undertaken.

A second area for Consortium activity is to become more active in disseminating research information for the planning and political community. How do we bridge the gaps between the generator of information and the ultimate user of that information? We've found that this is already a mandate of the Consortium. How can this disseminating be improved? Perhaps in a variety of ways: Through conferences such as this, through reports, through proceedings, etc. Then we zeroed in, as Group A did, that if we want to communicate we have to get maximum participation and attendance. We can do that more effectively, perhaps, in our own states by having either State-wide or sub-State workshops. We need to get our research information before planners, legislators, and consumators, and get some inputs from them within the workshop context, rather than a Consortium context, on what their research needs are.

During the course of our deliberations, we saw a book the Consortium has sponsored entitled "Research Priorities in the Rocky Mountain Area". Some of us had not seen it, and we think part of the communications gap could be bridged if that book could be made available.

A third area of activity in which the Consortium might become involved, is to conduct and evaluate--evaluate is a key word--research

on the policies, plans, and programs that are already on-line within government. This gets into the political arena, but if agencies of government and even legislatures desire this sort of evaluation of on-line programs, the Consortium--as an impartial research agency --might very well become involved.

Fourthly, again considering the communication gap, the Consortium could serve as a clearing house of intra-university and inter-university research, serving as a focal point, or funnel if you will, bringing the various research activities within the university to that focal point. Then when legislators, planners, county officials, etc., are dealing with questions such as energy, land use, or whatever, they do not have to scout the entire university terrain to find out what sort of research is being done. A clearinghouse role is not a monitoring role of research that goes on within the university. That would immediately get the Consortium into political problems within its own community.

These are the four basic recommendations. We agree that the basic theme running through all of them is that piece-meal planning will work more effectively in an atmosphere of maximum communication among politicians, planning communities, researchers, and their large academic communities.

When we turned to the specific research suggestions, we listed four, one of which was sort of analytic in nature, and three others which were a little larger.

First, the fairly narrow analytic one: Some research has already been done by the Consortium into tax problems of developing communities. We think this inquiry should be continued, focusing on taxes and revenues, not only of recreation communities but of developing communities as a larger generic class. These would include the retirement communities in Arizona, the recreational communities which are developing in new towns, and boom towns which are already developing or are going to develop in response to the energy crisis.

The second topic is an inquiry into the social, economic, and political impacts of these developing communities. This is separate and apart from the taxing problem. Just what will this development mean in terms of social and political impacts?

Participants worked in small teams to evaluate the symposium and develop recommendations for future research and programs for the Consortium.

Thirdly, we need research into planning methods and regulation which will take energy problems into account. Planning research never has done this very effectively. We pointed out the example that mass transit, which has always been a favorite child of the planning profession, has usually been advanced in terms of esthetics--it makes your community more esthetic, it improves the community lifestyle. But whether or not it is energy-efficient has not been examined closely.

Fourthly, we toyed with the concept of carrying capacity, human carrying capacity of land. We are not sure we understand what it means. One of our participants suggested that a better concept might be assimilative capacity of the land, in terms of assimilating the human beings who wish to dwell upon the land and use the resources. Is carrying capacity really an operational concept? If so, how can it be made useful to the planners and the political community?

One of our members suggested that we're throwing out new ideas for research, but the Consortium should not overlook the ongoing research, and specifically mentioned his own interest in stream flow methodology. Another member suggested that we do not want to lose sight of the bits and pieces of research that are underway, and that we should not lose sight of the importance of regional data banks or information banks. Another member suggested that the research which has been done to date was well and good, but we might argue that this has been single-disciplinary. He suggests we look at the possibility of interdisciplinary teams, working as team members on assigned research problems.

Group C Report

Robert F. Reiske, Leader

Environmental Review Officer
Department of the Interior, Washington, D.C.

(David B. Thorud, University of Arizona, Reporter)

Specific Question: What can the Eisenhower Consortium do to make the NEPA process more effective in reflecting local and regional concerns?

When we started dealing with this question, it immediately broadened into some greater issues. We found ourselves in agreement with the report that Dennis Thompson just presented, in that we felt there may be great merit in developing some type of "workshop" mechanism so that the Eisenhower Consortium could work with other cooperators to develop local programs on a State-wide basis. These workshops could deal with particular topics of interest to State and local planners. Also, perhaps we could develop a continuing structure of some sort at a local or State level where local planners and State agencies could contact one central point on problems of particular interest to them.

One way to start this kind of enterprise would be to have a workshop on a particular topic of interest. In Arizona, for example, the three universities could get together with the Forest Service and other land management agencies, and--working with the State planning offices and local and county government--sponsor a workshop. This sort of effort would be more than a mechanism for recording Eisenhower Consortium research results, or research at the other Arizona universities. It would be a mechanism for providing particular expertise that may be available at our universities and elsewhere, expertise that may be useful to the State and local planners. It would go beyond just the recording of research results.

Chances of success for this type of an effort would be at least partly dependent upon State and local receptivity to the suggestion. We think this type of a mechanism, this type of a localization mechanism, would also provide an opportunity for dealing with activities involving NEPA. It would appear to be entirely consistent with the Eisenhower Consortium concept, which embraces local function as well as the broader regional function, which I think this particular symposium represents. Our efforts in dealing with that particular question represent the essence of our discussion.

We also came up with three research areas that we think merit consideration. We didn't assign priority to these three areas because of time. One of the general research areas we titled approximately as follows: Social, economic, and legal implications of the merging land policy and planning systems, considering the rights, privileges, and responsibilities of land ownership, and also including the interactions between public and private wildlands and related properties. It would appear that what we can do as owners of private land may be changing now, and probably is going to change a lot more in the future. Therefore, we can expect some very significant social and economic problems associated with these changes.

A second research area we titled approximately: Studies of human behavior aimed at the development of improved resource management guidelines and practices for recreation use of wildlands. The objective here would be to reduce management costs, to reduce personal conflicts between users of different interests, and to enhance the quality of the recreation experience for all parties concerned. If we had a better understanding of how humans behave in a wildland environment we might be able--through our management techniques, campground design, how we separate different kinds of users, so on and so forth--to provide a happier experience. As an added benefit, maybe we can reduce costs

due to vandalism and other expressions of frustration.

There really hasn't been much work done on this aspect of human behavior. Presumably it would involve psychologists and sociologists at our universities, as well as our resource-managing personnel.

Our third and last specific recommendation is stated approximately as follows: Development of regional recreation plans which integrate the opportunities, facilities, and contributions provided by the public and private sectors in a particular region. Here we felt a very important step would be to consider the alternative trade-off relationships that can occur between the private and public sectors: What should the private sector handle in a particular region, and what should public sectors handle. This is another knotty problem we're facing in wildland management, with particular reference to recreational facilities and opportunities. What should be the trade offs between the public and private developments? We felt this would be a legitimate Eisenhower Consortium research topic, and probably of considerable interest to every State in the region.

Group D Report

Keith W. Hubbard, Leader

Arizona House of Representatives
Phoenix, Arizona

Specific Question: How could the Eisenhower Consortium help improve the process of public involvement in land management decisions?

Our group addressed itself to the question of the processes of public involvement. We concluded that one of the real problems is creating a desire, an awareness among the public.

One of the problems we have in obtaining public involvement is the matter of questionnaires. We're specifically concerned about the apparent restrictions placed on the use of questionnaires by the Invasion of Privacy Act. We would like to suggest that the Consortium go on record as requesting a review of that Act. To be specific, we could contact our forest experiment stations, regional foresters, and others who might have an influence in making whatever changes might be appropriate.

Another item we felt would be very important in strengthening public involvement is creating awareness on the part of the public that there are now existing systems of becoming involved. A large portion of the public is not even aware of what the methods are, or the systems that various organizations or States or groups may use. Perhaps money could be spent in television, newspapers, whatever way would be most effective to reach the public.

Another way of improving the process would be to improve our public meetings that are held for the very purpose of public involvement. It was pointed out in one of the papers yesterday that sometimes the things that are said in a meeting are just the opposite of what should be said.

We then spent the remainder of our time generating the five following recommendations for Eisenhower Consortium research:

First: Develop an educational curriculum to develop public knowledge of the concepts and agencies of resource and land management. Also in this educational curriculum we should develop early, similar to the Wildwood School that we saw in Aspen, an awareness in young

children of environmental considerations. We need to create an awareness in students, early in their lives, that they are needed in the public process of making decisions. And we should attempt to inform them of the methods by which they can become involved.

Second: Evaluate the in-house Forest Service training process on public involvement.

Third: Develop a regional working resource registry for consulting on short-run research problems. Many times the Forest Service or State or local planners need answers quickly. Perhaps the participating universities could develop a registry of their resources, and perhaps other related resources. They could then react on a short response basis, on a consulting basis, to help out where needed.

Fourth: Institute a comparative economic and resource study, including resource costs, of the various types of recreation. This general type of study has probably been done many times, but it was specifically pointed out that we should study the cost relative to the nonrenewable aspects of our natural resources, and the effects different types of recreation would have upon these resources.

Fifth: Establish a survey of the regional population expectations and impacts on resource and land management. The research could perhaps investigate polls and other methods of determining these impacts.

Symposium Wrap-Up and Concluding Remarks

Loren Potter, Biology Department
University of New Mexico

I have been asked to summarize what the Eisenhower Consortium is all about. I will therefore give you a brief historical summary to provide a base for proper evaluation of the Consortium, and the deliberations in which you have been engaged. We purposely did not give you this background earlier, in order not to prejudice you, or confine or restrict your innovative ideas. You will be able to find a little more of the philosophy and objectives of the Consortium in the preface to be printed at the beginning of the proceedings of this symposium.

In the beginning, we were fortunate in that the motivation came from above; somebody up in Washington said let us see the light, which made it easier than starting from below. So the program got going extremely fast. In 1972 we obtained some money through the Forest Service, we had a signed charter, and we had the goals that you have seen and heard about. They related to the role of man and forest and related environments. The charge was to do that kind of research which is not the function of the Rocky Mountain Forest and Range Experiment Station--with the principal emphasis on man, his impact, and the effects of such environments on man. The first year we had undesignated topics, 15 of them. The next year we picked out a theme, much of which has been reported here: The environmental costs and social benefits of second-home developments. We still wanted to keep the way open, however, for innovative new proposals, for which some money was designated, as well as some money which had to be used for particular purposes because of the source of funding. The third year we changed the emphasis to systems to move people to, through, within, and from wildland areas--basically transportation. We approved eight proposals with that theme, eleven proposals of new innovative ideas,

some renewals, and a number of projects which were controlled because of the source of funding. The growth in approved research proposals was from 15 to 22 to 34.

The current-year research is being done under a different kind of funding. An appeal was made to the Congress for an appropriation for the Eisenhower Consortium; $300,000 was awarded. So, a device was derived to start more consorting between the universities, to set up a system where there was an assurance that there would be an emphasis of research in each of three regions involving three universities. In each region, three topics would be worked on, so that at the end of a three-year period, we would be able to bring together the results of three regions and thus integrate the research in that way. This pattern assured that each university would be involved.

The mission which was selected, based on the appeal to Congress, was to evaluate the interactions of recreation use of forest areas and water quality, and to develop the technology, methodology, and guidelines for controlling undesirable effects. This was broken down into three attacks, or three approaches. The study of second-home development, other than high density; the development of high-density resort developments; and road-design developments and maintenance. The major thrust of the current year is in those directions. We are continuing some renewal proposals, if they fit into the general thrust, and we encourage smaller research proposals from people in law, sociology, behavior, and economics, as they relate to the major thrust.

That is where we are today: The emphasis is on interaction: both within the university and between universities, between the regions of the entire Consortium representation of nine universities, and with the Forest Service which is a member of the Consortium.

I would now like to summarize a few observations of my own. This is prejudice based on my own observations, but I cannot do otherwise. I will touch on some things which will summarize some of the ideas that have been presented. First, I perceive some various, apparent contradictions, that in truth turn out to be compatible interactions. For example, as one comes into Vail and sees the results of the investment of a great deal of money, it is a logical criticism to say this is a facilty of the wealthy. I would remind you very briefly of how this could be turned around quite differently. Historically, low-income skiiers using these recreational facilities would come to an area and sleep in a dormitory at a cost of $4.00 or $5.00. The changes in the values of real estate and the development of luxury accommodations made it impossible for such people to stay in this area. There was then a move to go to some other area for overnight lodging. Interestingly, however, recently there has been a move to come back and occupy the very luxurious condominiums which wealth has provided. For today the cheapest way for a low-income skiier to stay in the area on-site is for a group of six or eight to rent a condominium and enjoy the luxuries that have been provided by someone else. So the very thing which could be criticized as exclusive for the wealthy now becomes available and can be used as economical and practical lodging in luxurious style. I would remind you also that, in the middle of winter, this place is really buzzing, that this place is not run without thousands of young people who are able to enjoy the recreational facilities because there is employment.

As a second example or observation, we are looking at a very valuable mountain resort, under the regulation here and in many areas of the Forest Service. I would have you consider the number of people which are served by the recreational facility of the ski area per year. The density use is tremendous, and it is not any longer just seasonal. Compare that to other uses of forest areas in the West, and don't forget there is a responsibility to provide a facility for a high-quality experience to a lot of people, which is surely being done. Because of the large investment, it is possible for the operators of such areas to maintain a high-quality professional staff, and it is only possible to maintain the quality of the environment because of that fact. I am sure that the Forest Service would agree that their greatest problems are in areas which are being run on a shoestring.

Another interesting behavioral and sociological effect is that many of the resort areas such as this area, are run by people who are not just recreational managers or businessmen. Many of them are run by people who were

trained by the military at Camp Hale for the Tenth Mountain Division. Their love and interest in skiing resulted in their development of many of the western ski areas. If you want to look at sociological interaction, isn't this an interesting one? The point I really want to make is that they are a particular kind of people. They are a kind of people who are interested in maintaining the quality of the environment and a quality ski experience. This I do not think is true of the people who run Coney Island and many other recreational facilities. I think it's important to realize the nature and kind of a person involved.

I'd also like to make one other point relating a biological concept to politics. We have a very important concept in ecology of the balance of interacting factors or compensation effects. This is true in natural systems in biology more than it is in physical sciences. Natural systems evolve and they resolve the incompatibility by eliminating those incompatible aspects. They allow any successful varying combinations to exist. In other words, there are lots of different combinations of the factors to result in the same product. My point is this: man is now trying to set up legal restrictions to regulate specific factors in specific amounts without a proper recognition of the problem, and it may be an impossibility for man to set up such regulatory systems fixing the sets of combinations to accomplish the total product. So one has to be a bit careful about criticism of the legal profession for not properly establishing a set of laws to properly consider the totality of the operation, which one of the reporters just made reference to.

There is another very important aspect which makes it difficult to approach the total system, and that is the matter of adaptability. Natural systems change, they evolve. A great problem is that man has so greatly accelerated the changes that the system has not been able to evolve fast enough. Furthermore, man has become not only the principal manipulator but the principal user, and man is adapting faster than the change. The change that has occurred with recreational area development is amazing, how people become so satisfied with degradation; it is impossible to say that people require a particular experience. Their value judgments cover such a great range that it's impossible to establish any standard. In a recreational area, one person who wants solitude has been known to shoot at another person who wants to camp nearby. Other people will not camp unless there are 15 or more people a few feet away.

I think one other thing which has impressed me in this symposium is the need for some way to properly judicate the essence and real value of remarks and statements. For example, how does one evaluate the statement, "The ski areas cause a serious degradation of the area". How serious? In relation to what? It's like when someone asks you how's your wife, and you say in relation to what? What about the degradation of low-density areas, for example, grasslands on the Navajo Reservation? From what we have seen on this trip there's no comparison; in fact, the ski resort areas that we have seen on the field trip might be taken as model examples of preventing the degradation of the environment.

A couple of ideas relate to hypotheses in the future. I would like to emphasize to you, in regard to your experience in this symposium, that you weigh carefully the goal of the symposium and the breadth of the symposium approach. Do not use the same criteria that you would use if the symposium had been on a very specialized topic, where the depth of your increased knowledge would have been greatly advanced. If you will look back on the last days and realize what a tremendous gamut of ideas and problems you have seen, then you must use the criteria of evaluation appropriate for that experience. In that regard I would like to remind you that educational experience is principally learning, not teaching. I would like to emphasize the importance, for the future, of people going through this experience of learning on-site--having the technical knowledge which you have received in a more formal way in the last two presented days on-site, so that there can be a greater exchange of ideas, of argumentation and learning, after recognizing the problems and getting suggested solutions from the experts. I think what is learned will be remembered a great deal longer. And lastly, an impression that no matter what plan anyone comes up with to accomplish anything, it really depends upon high-quality personalities and people who are greatly devoted. Some things therefore are beyond mere planning.